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5th International High-Speed Congress • October 16-22 • Sheraton-Park, Washington, D. C.

volume 69 • number 6

JUNE 1960

JOURNAL of the SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

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A Vertical Aperture Equalizer for Television

By W. G. GIBSON
and A. C. SCHROEDER

A vertical aperture equalizer employing delays of one scanning line has been built and has been used on commercial broadcasts to increase the subjective sharpness of television pictures. By using both vertical and horizontal aperture equalization, optical aperture defects can be corrected. By the use of vertical aperture equalization and scanning apertures with suitable responses, television in the future may be practically free of line structure and spurious pattern effects due to the scanning-line structure.

IN AN EARLIER PAPER,¹ the various ways of performing vertical aperture equalization which were known at that time were described. Several of these methods had actually been tried by the authors. However, the methods that had been tried had one drawback in common: they required that the signal be in a two-dimensional configuration. This meant that the vertical aperture equalization had to be done at each pickup camera or in some type of storage tube. A very useful device would be a "black box" vertical aperture equalizer which could operate on any one-dimensional time-varying television signal. This paper concerns such a device.

Line Delay Aperture Equalization

Referring to Fig. 1, which represents a small segment of a television raster, vertical aperture equalization is accomplished by subtracting information in areas Nos. 3 and 7 from picture element No. 1, the need for vertical aperture equalization having arisen because of the spread of information from picture element No. 1 to areas 3 and 7, and vice versa.¹ Element 1 is the picture element with which we are concerned, and elements 2 through 9 are the surrounding picture elements or, more generally, the adjacent surrounding areas. By means of a 1F delay, the information pertaining to picture elements 1, 3 and 7 can be obtained simultaneously. A 1F delay represents a delay of one field or of one field plus and minus the delay of half a scanning line, depending upon the

context. (Because of interlaced scanning, a delay of exactly one field is a position displaced horizontally by half a scanning-line width from the starting point. To obtain the information in picture elements 3 and 7, a delay of half a scanning line must now be respectively subtracted from, or added to, this delay of exactly 1F. However, if delaying sync or blanking for a field is being considered, then a 1F delay represents a delay of one field exactly, so that in this case the plus and minus delays of half a scanning line are ignored.) If these three pieces of information are available simultaneously, the subtraction operation can then be performed.² However, for the video bandwidth required in television, accurate time delays of 1F, approximately 16,600 μ sec, (microseconds), are not practical at present. On the other hand, accurate time delays corresponding to one television scanning line of 63.5 μ sec are practical.³ This amount of delay is called a 1H delay. Because of interlaced scanning, 1H delays make it possible to have simultaneously the information pertaining to picture element No. 1 and the picture elements two raster lines removed from it (one just above picture element 3 and the other just below 7). Figure 2 is a general block diagram of a delay-line type of equalizer. The type of vertical aperture equalization obtained by this method will now be examined in more detail.

Let the main signal into the adder of Fig. 2 be represented in the vertical direction by

$$S_m = u \sin 2\pi A d \quad (1a)$$

where u is an arbitrary constant, A is the number of brightness alternations (e.g., black-to-white-to-black is one

alternation) per unit picture distance and d is the distance in unit picture distances. Furthermore, we shall let the unit picture distance correspond to the picture height, so that d is the distance measured in fractions of the picture height. Since

$$N = 2A \quad (2)$$

where N represents the resolution in line-number as it is conventionally used in television,

$$S_m = u \sin 2\pi \frac{N}{2} d \quad (1b)$$

Information handled by standard television methods originates and terminates in the form of a two-dimensional display. Equation (1) can be used to describe the charge distribution on the target of the camera or the light distribution (as a photographic exposure of one frame would record it) on the kinescope. A more generalized space description of a television picture in two dimensions, presented in an early paper,⁴ used a notation different from that in Eq. (1), but the simplified expression of Eq. (1) is sufficient for our purpose. Equation (1) is analogous to the more familiar expression

$$e = E \sin 2\pi f t \quad (3)$$

which is often used to describe a television signal but which could be considered a much less general expression as it is restricted to the horizontal direction and to a definite rate of scan in the horizontal direction. In between the two ends of the system the television signal is normally considered to be a one-dimensional

2	3	4
9	1	5
8	7	6

Fig. 1. Small segment of a TV raster.

A contribution submitted on February 26, 1959, by W. G. Gibson and A. C. Schroeder, RCA Laboratories, David Sarnoff Research Center, Princeton, N. J.
(Final manuscript received November 2, 1959.)

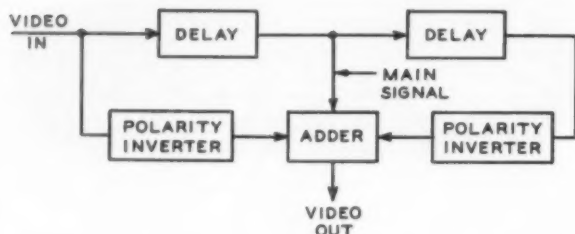


Fig. 2. General block diagram of a delay-line type of equalizer.

time-varying signal such as described by Eq. (3), in regard to which Eq. (1) may not appear to have much utility. However, because of the use of 1H delays in the block diagram of Fig. 2, we are processing together three signals that have primarily a vertical space relationship to each other, so that it is legitimate to use Eq. (1) in examining what happens in this process of vertical aperture equalization.

Let the other two signals into the adder be represented by

$$S_1 = v \sin 2\pi \frac{N}{2} (d - \Delta) \quad (4a)$$

$$S_2 = v \sin 2\pi \frac{N}{2} (d + \Delta) \quad (4b)$$

where Δ corresponds to a distance of two lines (orthogonal to the scanning structure) out of a total of 480 active lines per unit picture distance or per picture height.

$$\Delta = \frac{2}{480} = \frac{1}{240} \quad (5)$$

The output of the adder of Fig. 2 is

$$S_0 = S_m - S_1 - S_2 \quad (6a)$$



Fig. 4. Oscillograms in the vertical direction: A, unequalized; B, detail signal; C, equalized.

$$S_0 = u \sin 2\pi \frac{N}{2} d - v \left[\sin 2\pi \frac{N}{2} (d - \Delta) + \sin 2\pi \frac{N}{2} (d + \Delta) \right] \quad (6b)$$

In order to obtain our mathematical results in a form similar to the actual operation of a vertical equalizer using a "detail signal," which is described later, let

$$u = 1 + \frac{a}{2} \quad \text{and} \quad v = \frac{a}{4}$$

and simplify,

$$S_0 = \left(1 + \frac{a}{2} \right) \sin 2\pi \frac{N}{2} d - \frac{a}{2} \cos 2\pi \frac{N}{2} \Delta \sin 2\pi \frac{N}{2} d \quad (6c)$$

$$= \left(1 + \frac{a}{2} - \frac{a}{2} \cos \pi N \Delta \right) \sin 2\pi \frac{N}{2} d \quad (6d)$$

$$= \left(1 + a \sin^2 \frac{\pi N \Delta}{2} \right) \sin 2\pi \frac{N}{2} d \quad (6e)$$

$$= \left[1 + a \sin^2 \left(\frac{\pi}{2} \cdot \frac{N}{240} \right) \right] \sin 2\pi \frac{N}{2} d \quad (6f)$$

Equation (6f) is shown in Fig. 3 in which the resolution of maximum response occurs at 240 lines with the boosting of vertical detail decreasing at higher resolutions, approaching unity gain or zero boost at 480 lines. This curve is quite similar to that for the horizontal aperture equalizers used in conjunction with color cameras; such equalizers also have a resolution of maximum response in the horizontal direction of about 240 lines.

The response vs. resolution characteristic in the vertical direction is a composite of the scanning structure and the aperture response characteristics. No mention has been made of what this composite characteristic may be for some typical aperture,^{5,6} but the coefficient from Eq. (6f)

$$R_1 = 1 + a \sin^2 \left(\frac{\pi}{2} \cdot \frac{N}{240} \right) \quad (7)$$

is the multiplying factor of this characteristic when 1H delay vertical aperture equalization is employed. The response curve for this type of equalization can be determined by graphical analysis of square waves in the vertical

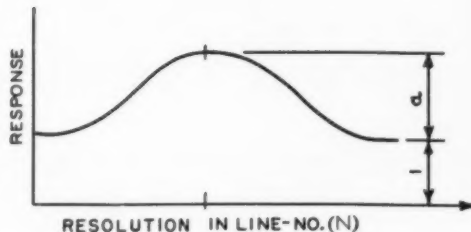


Fig. 3. Equalizer response characteristic.

direction. The actual mechanics of doing this is somewhat tedious and involved; however, for various assumed conditions, square-wave analysis showed that regardless of the type of interference with line structure for different positions of the square waves with respect to the scanning lines or regardless of the type of pickup or reproducing aperture, the response curve of the equalization has a shape like that of Eq. (7) and has its peak at 240 lines. It should be emphasized that the peak of response is at 240 lines but that the peaking continues out to 480 lines, and that the response vs. line-number characteristic in the vertical direction is not a discontinuous function because of the scanning lines.

Figure 4 consists of oscillograms showing responses in the vertical direction. The signals shown in Fig. 4 originated in a flying-spot slide scanner. The test pattern slide consisted of seven groups of resolution bars, the bars having the following resolutions in line-number: 80, 120, 160, 200, 240, 280 and 320 lines. The slide was inserted in a position rotated 90° from the usual way for examining horizontal resolution, so that it would display vertical resolution. The oscilloscope was adjusted so that each sweep displayed a field. Note the vertical sync pulse and the envelope of the horizontal sync pulses in Figs. 4a and 4c. Figure 4a is the signal before vertical equalization. Figure 4b (magnified in the photograph) is the "detail signal," which is described later, that is added to the signal of Fig. 4a to form the vertically equalized signal of Fig. 4c. The signal of Fig. 4b corresponds to the term

$$a \sin^2 \left(\frac{\pi}{2} \cdot \frac{N}{240} \right) \sin 2\pi \frac{N}{2} d$$

of Eq. (6f). Note the beats in the higher resolution groups, but the envelope follows the prescribed curve fairly closely.

When a scanning aperture enlarges and decreases its ability to reproduce fine detail, it usually spreads out in all directions independently of the direction of scan. Referring again to Fig. 1, this means that information from areas Nos. 2 through 9 spreads over into picture element No. 1 and vice versa. Vertical aperture equalization equalizes for the effects from areas Nos. 3 and 7, and horizontal aperture equalization equalizes

for the effects from areas Nos. 5 and 9, leaving the effects from areas Nos. 2, 4, 6 and 8 apparently unequalized, if one considers the problem of equalizing the aperture response in all directions, irrespective of the direction of scan. It may not be obvious, and a complete explanation is beyond the scope of this paper, but the proper combination of vertical and horizontal aperture equalizations equalizes for the information spread in the diagonal directions from picture element No. 1 toward areas 2, 4, 6 and 8 by a process similar to vector addition. Thus, by means of electrical circuitry, optical aperture defects can be compensated for.

Experimental Model

A laboratory vertical aperture equalizer using a pair of 1H delay lines was built and has been in commercial operation. It has been used with outdoor color pickups and with black-and-white kine-scope recordings. Basically, it is shown in the block diagram of Fig. 2, the delays now being one line long. However, for simplification of operation and so that it could be used for composite color signals, a number of modifications were made.

For large areas where each line is like every other, subtracting signals from adjacent lines is like subtracting a signal from itself; therefore, as more equalization is desired and more adjacent line signal is subtracted, less overall large-area signal remains. This means that whenever the amount of equalization is changed, the gain must also be changed. To avoid this, a "detail signal" is first made which has no large-area information. This is done by subtracting enough adjacent signal information to cancel

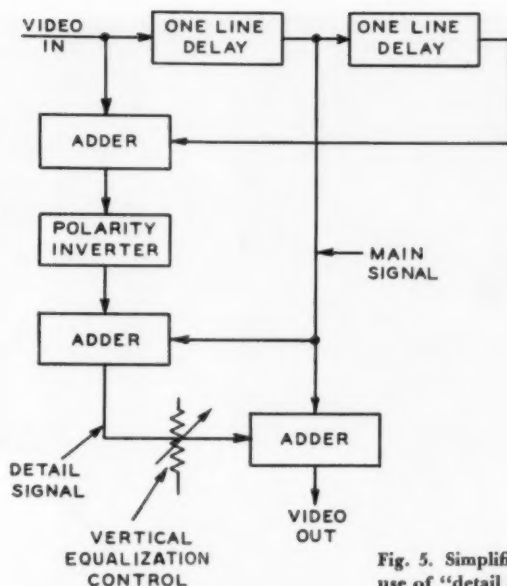


Fig. 5. Simplified block diagram showing use of "detail signal" in equalizer.

completely the signal when the adjacent lines are like the desired line. The detail signal is a signal containing just vertical detail. This detail signal is then added in any desired amount to the main signal to give any desired degree of equalization without requiring a change of gain. A block diagram of this arrangement is shown in Fig. 5. This is the basic "operational" arrangement. The Vertical Equalization Control corresponds to the coefficient a in Eq. (7).

Figure 6 is a complete block diagram of the unit. The incoming video signal is modulated onto a 30-mc carrier because of the nature of the 1H delay line.³ This consists of a piece of amorphous quartz with piezoelectric quartz

crystal transducers attached to both ends to make the transformations between electrical and mechanical vibrations. The long delay is obtained by the time taken for the mechanical vibrations to travel through the amorphous quartz. The delay line is contained in a case about 5 in. in diameter and 1½ in. thick. The ultrasonic quartz delay lines have an attenuation of about 40 db and are therefore followed by 30-mc bandpass amplifiers similar to television IF amplifiers. The once-delayed and twice-delayed signals are detected separately and then applied to trimming delays consisting of ordinary RG-65U coaxial delay cable. These trimming delays are required as it was not prac-

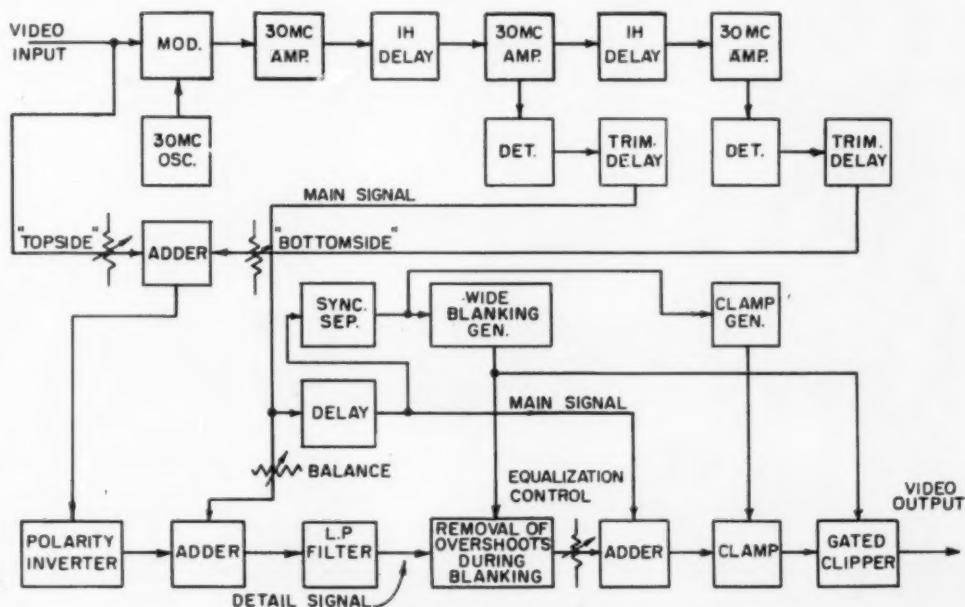


Fig. 6. Complete block diagram of equalizer.

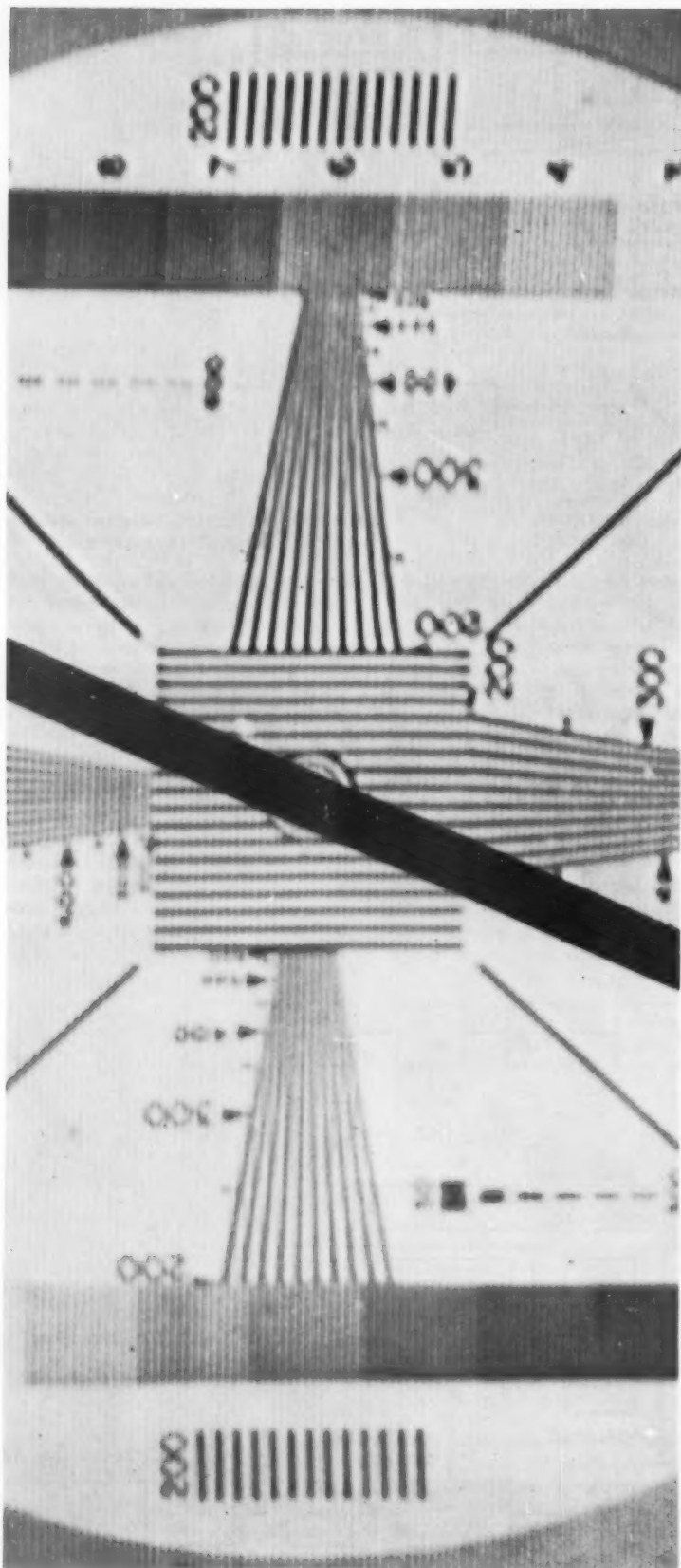


Fig. 8. RMA test pattern, with vertical aperture equalization on the right side.

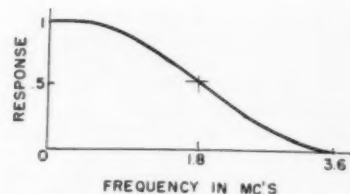


Fig. 7. Low-pass filter characteristic.

tical to design the combined delay of the quartz delay line and associated circuitry to the desired accuracy of ± 0.05 μ sec, which is approximately \pm half a picture element. If the 1H delay varies a little, 0.05 μ sec for example, the result is merely a shift from vertical equalization toward "diagonal" equalization. In normal operation of this unit, the delay has remained constant enough for all practical purposes, after the operating temperature of the quartz delay lines has stabilized. The trimming delays are set so that the 1H delay equals the horizontal period of a crystal-controlled color sync generator. If the sync generator is locked, for example, to the 60-cycle power mains, then variable trimming delays controlled by servos would be required instead of fixed trimming delays.

The detail signal is made next by subtracting the proper amount of the "topside" (undelayed) and "bottomside" (2H delayed) signals from the main (1H delayed) signal so that the detail signal contains only vertical detail, as mentioned earlier. The names "topside" and "bottomside" refer to that side of an edge which each of the signals affects. In color television, the 3.6-mc color subcarrier reverses polarity each line and, therefore, looks like vertical detail. A vertical aperture equalizer would then increase the chroma as it increased the vertical sharpness. This is remedied by inserting a linear phase low-pass filter in the detail signal path to remove the 3.6-mc color subcarrier and the more prominent sidebands. Figure 7 shows the response characteristic of this low-pass filter. It has been observed experimentally that limiting the bandwidth of the vertical detail signal in this manner has very little subjective effect on the vertical aperture equalization thus obtained.

This equalizer was designed to operate on composite signals containing both sync and chrominance, so additional circuitry is required in addition to the filter mentioned above. During a time interval slightly longer than composite picture blanking, the detail signal is blanked out with specially generated wide-blanking pulses. This keeps undesired overshoots from occurring on sync and blanking edges. Note that in the vertical aperture equalizer, overshoots of vertical blanking are one line long. The detail signal is now added to the



Fig. 9. Effect of absence of equalization.

main signal forming the vertically equalized signal. A simple clipper removes whiter-than-white overshoots but a gated clipper is required to remove blacker-than-black overshoots so that sync and color burst will not be affected. The amplitude of the color subcarrier and its sidebands is lowered before clipping and raised back to normal afterward so that the chroma information will not be affected.

Figures 8 to 10 demonstrate the picture-sharpening effects of 1H-delay vertical aperture equalization on a signal from a vidicon pickup tube. Figure 8 is a portion of the composite of two separate photographs of the RMA test pattern, one with and one without vertical aperture equalization. The left side does not have any vertical equalization but the right side does. It should be pointed out that the increase in subjective picture sharpness

obtainable by using vertical aperture equalization seems to be reasonably independent of the presence or absence of horizontal aperture equalization. For the sake of simplicity this effect is not shown here, but it is shown in the photographs of the previously mentioned, earlier paper on this subject.¹ The video signals used to produce the pictures of Figs. 8 to 10 do not have any horizontal aperture equalization.

The equalizer was made on two chassis. Figure 11 shows the 1H Delay Unit which generates the three signals delayed with respect to each other by 1 and/or 2 lines. Figure 12 shows the Signal Processor, which contains the timing circuits and performs the various required operations on the video signals. The upper blocks of Fig. 6 correspond to the 1H Delay Unit and the lower blocks to the Signal Processor.



Fig. 10. Effect of vertical aperture equalization.

Vertical aperture equalization has some interesting characteristics not mentioned previously that do not apply, in general, to horizontal aperture equalization. Since the detail signal is passed through a low-pass filter, this signal does not contain high-frequency noise. As the amount of vertical equalization desired is increased by increasing the amount of the detail signal that is added to the main signal, the signal-to-noise ratio does not deteriorate, in general, as fast as it does for an equivalent amount of horizontal aperture equalization. This is especially true for signals having more noise in the high-frequency end than in the low-frequency end of the video spectrum. Another interesting characteristic arises from the fact that a vertical aperture equalizer can operate on a composite color signal. Therefore, only one vertical equalizer is required

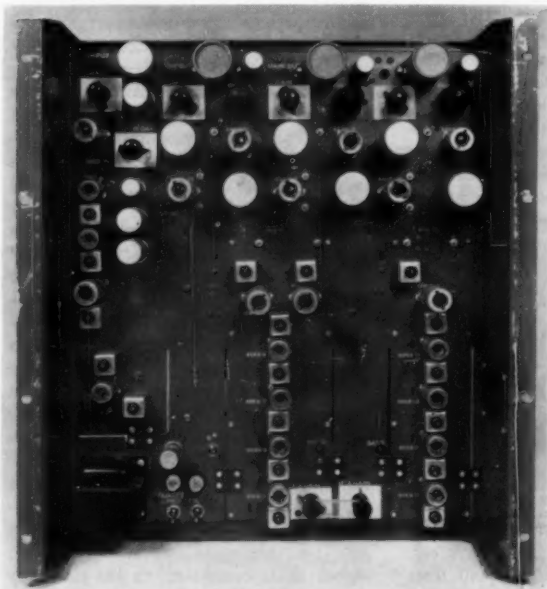


Fig. 11. 1H delay chassis.

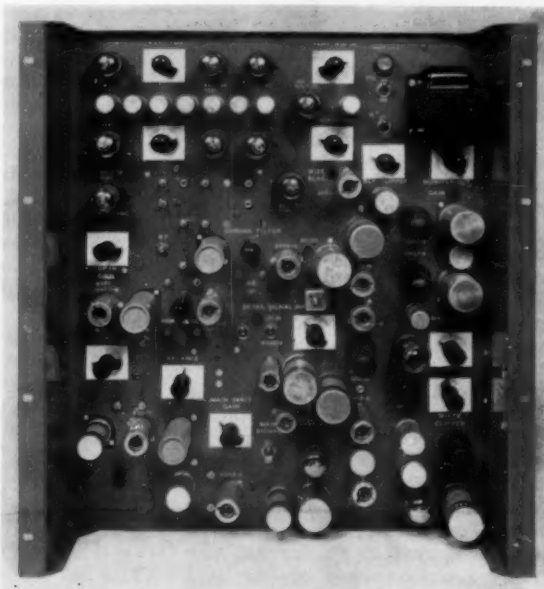


Fig. 12. Signal processor.

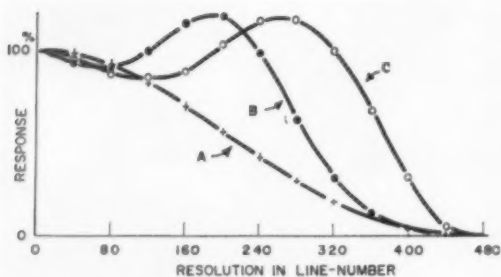


Fig. 13. Equalized aperture characteristics.

for a multiplicity of color cameras. Another interesting characteristic of vertical aperture equalization is that all receivers benefit, irrespective of the bandwidth limitations of the receiver. This is not the case for horizontal aperture equalization.

Line Structure Compensation¹

Under present scanning methods, television pictures have defects in the vertical direction that they do not have in the horizontal direction. These defects are due to the scanning structure and consist of line structure visibility, moirés in repeating patterns, and spurious signal beats between picture information and the scanning structure of the picture. The interesting relationship between scanning structure defects and vertical aperture equalization is as follows. An "ideal" scanning aperture would have a light distribution in the vertical direction of $\sin X/X$ (with zeros occurring at line pitch) at both pickup and reproducer.⁶ This would yield a flat field with no very serious spurious patterns due to the scanning-line structure and full response out to 480 lines (no response beyond 480 lines). The "Kell factor,"⁷ which is a measure of the effectiveness of the scanning lines in reproducing vertical detail, would be unity. In fact, the direction of scan could not be determined in such a case. Aperture responses of $\sin X/X$ are not physically realizable. Other aperture distributions, cosine-squared for example, can yield a flat field and no spurious scanning beat patterns but the resolution vs. line-number characteristic of a system with such a composite aperture response is relatively poor as shown by curve A in Fig. 13. This relatively poor aperture response can be improved by means of vertical equalization, so that it appears that physically realizable scanning apertures used in conjunction with vertical aperture equalization can approach the performance of a $\sin X/X$ scanning aperture, within the limits of phosphor persistence and nonlinearity (reproducing apertures cannot supply negative light). For example, an aperture with a cosine-squared distribution has very nearly a cosine-squared response as a function of line number.⁸ A $\sin X/X$ aperture has a rectangular response.

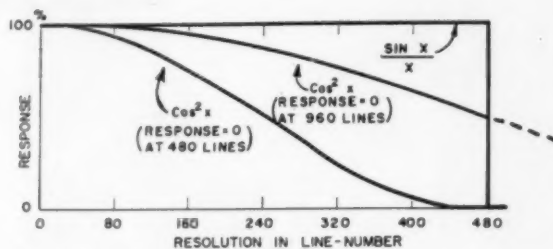


Fig. 14. Some aperture characteristics.

See Fig. 14. If at the pickup this cosine-squared response is 0 at 480 lines, a flat field of pickup with no spurious scanning patterns is obtained. If at the reproducer the cosine-squared response is 0 at 960 lines, a flat field of visibility (no visible scanning structure) is obtained. The combined vertical response of both pickup and reproducer scanning apertures without aperture equalization is then

$$R_0 = \cos^2 \left(\frac{\pi \cdot N}{2 \cdot 480} \right) \cos^2 \left(\frac{\pi \cdot N}{2 \cdot 960} \right) \quad (8)$$

where the first term is due to the pickup and the second term to the reproducer. Vertical aperture equalization using 1H delay lines has the property of multiplying this by

$$R_1 = 1 + a \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 240} \right) + b \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 120} \right) + \dots \quad (9)$$

where the second term requires 1H delays, the third term requires 2H delays, etc. The third term is derived by noting that for 2H delays (see Eq. (5))

$$\Delta = \frac{4}{480} = \frac{1}{120} \quad (10)$$

This gives equalization (by means analogous to transversal filters⁸) whose response is symmetrical above and below 240 lines and of any desired shape. This equalization can therefore compensate out to 240 lines as accurately as is desired consistent with the number of 1H delays used. By means of a combination of 1H and 1F delays the equalization has the property of multiplying by

$$R_{11} = 1 + a \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 480} \right) + b \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 240} \right) + c \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 160} \right) + d \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 120} \right) + \dots \quad (11)$$

where the second term requires 1F delays, the third term 1H delays, the fourth term a combination of 1F and 1H delays, the fifth term 2H delays, etc. This can compensate out to 480 lines in the limit. It might be noted here that for symmetrical vertical equalization two

1H delay lines are required for each 1H delay but that only one 1F delay line is required (if motion is neglected.)

To compare the equalization obtained using 1H delays with that using a combination of 1H and 1F delays, take, for example, a system having scanning apertures giving the response of Eq. (8). This is plotted as A in Fig. 13. If this is passed through an equalizer having two pairs of 1H delay lines adjusted to multiply by

$$R_{12} = 1 + 1.3 \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 240} \right) - 0.45 \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 120} \right) \quad (12)$$

we get the overall response plotted as B of Fig. 13. If, instead, it is passed through an equalizer having 1F and 1H delays adjusted to multiply by

$$R_{13} = 1 + 8 \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 480} \right) - 2.3 \sin^2 \left(\frac{\pi \cdot N}{2 \cdot 240} \right) \quad (13)$$

we get the overall response plotted as C in Fig. 13. Curve C has roughly the same shape as curve B but the response holds up for higher resolutions. However, at the present state of the art, 1F delays seem to be impractical and fortunately, the additional response obtained by using them seems to be of much less importance than the amount that can be obtained by means of 1H delays. This does not mean that 1F delays would not be used if they were made available.

These processes do not require a change in television broadcasting standards. The example described here in Eqs. (8) to (13) requires, for optimum benefit, (1) that the broadcaster have a vertical equalizer that is somewhat more complicated than the "simple" vertical equalizer described earlier in this paper and (2) that the receiver manufacturer control the aperture response of the kinescopes reasonably accurately. Fortunately, the broadcaster does not have to wait for the receiver manufacturer. He can transmit now a vertically aperture-equalized signal that, compared to his presently transmitted signal, will have more contrast in the fine detail in the vertical

direction and will be practically devoid of spurious signal beats between picture information and the scanning structure, and all receivers will benefit by this. Independently of this improvement and possibly at some later date, receiver manufacturers can shape their kinescope apertures properly to eliminate line structure visibility. This technique should be very helpful, also, in making kinescope recordings or in converting from one set of television standards to another, since both these operations are plagued with problems arising from line structure effects. Using this general approach, then, television in the future may have

greatly reduced spurious pattern effects due to the scanning-line structure.

Acknowledgments

The encouragement of R. D. Kell in this project and the assistance of M. H. Mesner and W. J. Howarth in preparing the equalizers for commercial testing use are gratefully acknowledged.

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Application of the TV Tape Recorder to Radar Signal Recording

By ANTHONY W. SEVERDIA

The TV tape recorder, initially developed to satisfy the needs of the broadcasting industry for high-quality recording and reproduction of TV pictures, is also becoming rapidly accepted in the fields of industrial and military technology because of its inherent wideband signal handling capabilities. This paper discusses the fundamental system concepts of the recorder, and presents the basic considerations in the application of the recorder for use in pulsed radar signal recording.

THE TELEVISION TAPE RECORDER, rapidly accepted by the television industry over the past three years, is also admirably suited to the recording and reproduction of other short-term electrical phenomena because of its wideband signal handling capabilities. A close kin to television, the recording of radar signals with near perfect fidelity is today a reality, whereas only three years ago the technique was only a desire in the minds of scientists and engineers.

Many schemes have been described in the literature for simulating radar signals for test and training purposes.¹ One scheme — for training purposes — has been based on the recording of PPI displays by means of photographic film.² At best, these approaches have necessarily compromised complete realism of dynamic target data. Realistic and reliable presentations of both airborne and ground radar observations can be obtained if the video output and associated signals of an operating pulse radar set are stored on magnetic tape for later reproduction on standard display units, or, perhaps more important, for later transmission to data reduction systems.

Presented on October 9, 1959, at the Society's Convention in New York by Anthony W. Severdia, Ampex Corp., 934 Charter St., Redwood City, Calif.

(This paper was first received on January 13, 1960, and in final form on April 14, 1960.)

Capabilities of the Standard TV Recorder

In order fully to understand the capabilities of the TV tape recorder as a radar recorder, it is advisable to review briefly the operation of the standard system. For purposes of illustration, a simplified block diagram of the Ampex Model VR-1000-B is shown in Fig. 1.

As in other tape recorders, the system is composed of two main equipment groupings: the mechanical drive components to transport the tape and the signal components for supplying the required head record currents plus the readout means. The unique portion of the TV recorder is the head transport mechanism (considered a part of the mechanical components) which rotates the video signal channel heads transversely to the tape, producing an effective writing speed of 1500 ips (inches per second).³

The basic mechanical system employs two electronic servo-control systems wherein the rotating head velocity and the tape speed are controlled. The timing reference of the head drum is referred to the 60-cycle vertical sync interval of a standard TV signal, and, in record, the capstan drive is referred to the angular position of the head drum, establishing a definite phase relationship between the two at all times; in this way, regardless of phase changes or frequency differences in the reference frequency, the

tape is proportionately metered to maintain consistent transverse track spacing dimensions. Although tape slippage is a minute but nevertheless contributory variable in record, its effect is nullified in the playback mode. During the record mode, the angular position of the head drum is recorded longitudinally along one edge of the tape in the form of a 240-cycle signal; thus all timing variations, including random variations due to tape slippage, are preserved for later interpretation. During the playback mode, the head drum is servo-controlled with respect to the stable frequency as in record; the capstan drive is also servo-controlled by the comparison of the control signal from tape with respect to the drum angular position. The tape travel is thus precisely the same as it was during record, resulting in perfect tracking of the transverse recorded tracks with respect to the rotating heads.

The video signal channel takes advantage of the bandwidth capabilities afforded by the high writing speed of 1500 ips. This speed, coupled with the electrical capabilities of the head construction, allows the recording and recovery of signals of 1-10 mc. In practice, the recorded signal is a frequency-modulated carrier plus sidebands, derived from video modulation of an oscillator deviated in frequency between the limits of 4.3 and 6.8 mc. The rf signal simultaneously excites the four rotating heads although only one of them is in contact with the tape for a large portion of time. At the beginning of each head sweep, two heads are in contact with the tape; some overlap of identical information is thus generated and constitutes the period

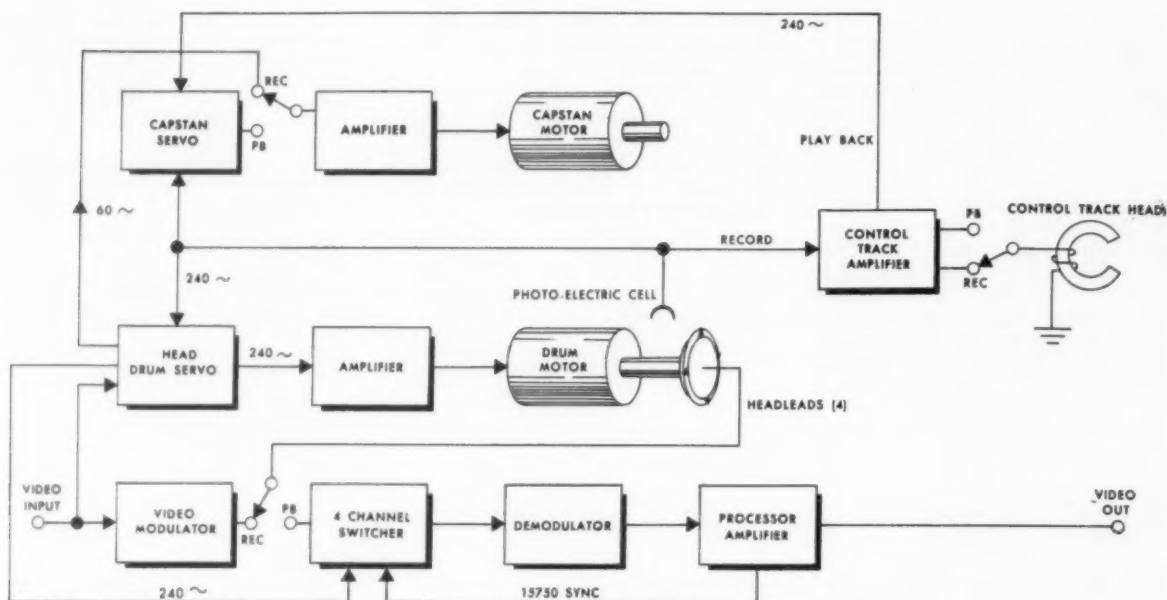


Fig. 1. Simplified block diagram of video and servo circuits of Ampex Model VR-1000-B Tape Recorder.

during which head switching is accomplished during the playback mode.

In the playback mode, the head signals produced as each head passes over the recorded track are switched by a timing signal derived from the angular rotational position of the head drum. In the Ampex system, the timing signal is generated by means of a light source and photoelectric cell focused upon an alternately black and white ring in 180° segments rotating with the head motor shaft. The signal emanates as a 240-cycle square wave which is formed into a 240-cycle trapezoidal wave and, through frequency multiplication and shaping, also to 480-cycle waves. By delay and combination of the latter two waves in various phase relationships, a 960-cps switching rate is established and applied in their various combinations to four-gated amplifiers in the head-switching unit to which each respective head signal is also applied. The action is sequential, only one amplifier of the

four being gated on at a time, and the "on" amplifier corresponding to that of the active head being in contact with the tape at the time. The switching action results in a continuous rf envelope which is the gated sum of the signals from the four heads. In television recording, the precise switching time is made to be coincident with the horizontal blanking interval of the television picture.

The rf envelope is then demodulated, and the resulting video information is processed so as to eliminate the transient produced at the time of head-switching and to reshape the sync pulse intervals.

Although not shown in Fig. 1, the system also provides for the longitudinal recording of two audio channels of 10- and 6-kc bandwidths, respectively.

Considerations for Pulse Radar Signal Recording

The TV Tape Recorder is directly adaptable to pulse radar recording with

relatively minor changes. The main consideration, that of bandwidth, is immediately satisfied by the wideband (30 cps to 4.2 mc) capabilities of the system. A pulse-rise time of 0.2 μ sec, although not ideal for radar recording, is entirely acceptable in most such applications. The dynamic range of 36 db and the amplitude linearity of better than 10% both readily satisfy all but the most critical applications.

Because the precise character of the radar signal is in many ways quite different from the television signal, other considerations such as time-base stability, input signal handling methods and switching transients suppression can be satisfied by modification of, or addition to, certain components within the system.

Examination of Fig. 2 will disclose the general character of the pulse radar video signal on a linear time-base display. The trigger pulse (transmitted pulse) duration is commonly between

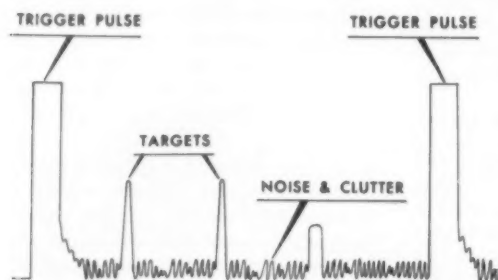


Fig. 2. Pulse radar video signal on a linear time-base display.

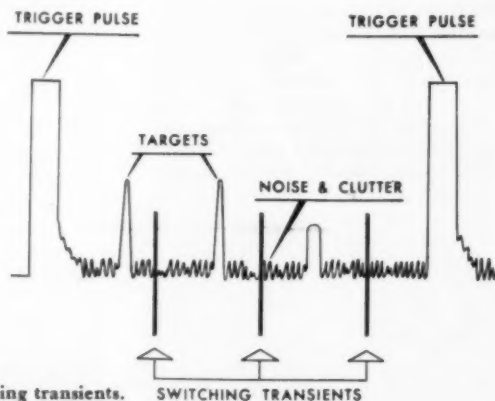


Fig. 3. Radar signal with switching transients.

0.5 and 4.0 μsec ; the trigger pulse repetition period varies widely, dependent on radar range, from 500 μsec to 4 msec. For example, consider the trigger pulse length of 1 μsec and a repetition period of 4 msec; the recovered raw video signal is depicted in Fig. 3. Note that several extraneous signals have been introduced as a result of head-switching. These signals are in fact transients with the duration of approximately 0.2 μsec and with a repetition period of 1040 μsec . As mentioned earlier, in TV recording the transients are placed outside the picture area and are then suppressed by the processing amplifier. In radar recording, however, we are not so fortunate as to have a convenient place to "bury" the transient unless the trigger repetition period coincides with the switching period. Several successful schemes have been devised to eliminate the switching transients with a minimum loss of target information. In actual practice, the loss of information is not disastrous inasmuch as the head-switching periods shift in phase with respect to the pulse repetition period. A block diagram of one transient eliminator approach is shown in Fig. 4.

Here the recovered video signal is coupled to a gated amplifier stage. The 480-cycle square-wave switching signal from the system rf switchers is coupled to a pulse-forming network whose output is gating pulses at a 960-cycle rate coincident with the switch time. The duration of these pulses is 0.5 μsec . The pulses gate off the video signal amplifier during the transient interval. A clipper removes the undesirable excursions which result from the gating process and the output appears as in Fig. 5. The transient suppressor amplifier replaces the processing amplifier found in the standard television recorder.

The video signal input circuitry prior to the modulator stage consists of several video amplifier stages incorporating pre-emphasis and equalization, and television signal backporch clamping. Only minor modifications of the standard circuitry are required to alter the clamp circuit so as to make it suitable for operation with the pulsed radar signal.

The short-term time-base stability of the video channel is exceptionally good, in view of the mechanical elements of the rotating head. Stated in familiar tape-recorder terms, the peak flutter is about 0.0033%! This figure seems all the more remarkable when one considers that peak flutter of around 0.05% is deemed excellent with more

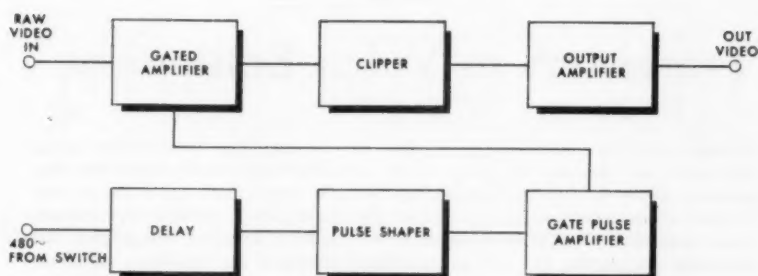


Fig. 4. Block diagram of transient suppressor.

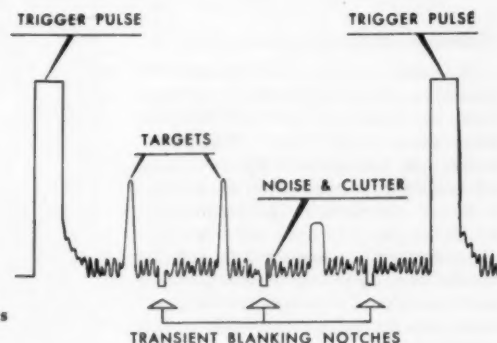


Fig. 5. Radar signal, transients suppressed.

conventional tape-transport mechanisms.

Major flutter components are centered about a 10-cps rate of roughly sinusoidal form. Translated to useful figures for radar time bases, assuming a 4-msec period between trigger pulses, the result in peak pulse jitter would be 0.135 μsec at the end of the 4-msec interval. In other terms, the peak error introduced by the recorder system between trigger and farthest target would be 0.0033% — a very acceptable figure in most applications. Long-term base stability is entirely a function of the reference frequency standard applied to the head drum servo unit. In TV recording, the vertical sync interval is extracted for timing and phase lock purposes, and is quite acceptable to that application. Since no such signal is directly available from the radar waveform, a crystal-controlled frequency reference having a stability of one part in 10^5 or better is normally utilized. A 60-cycle power-line frequency may also be employed where the supply frequency and phase do not change abruptly and where time-base expansion or contraction of approximately 1% can be tolerated.

Operational radars also include numerous other signals of low frequency such as those associated with azimuth and elevation synchro-circuits. It is essential that these signals accompany

the recording of the video information so that all useful parameters will be reproduced upon replay of the tape. Because the form of these additional data varies widely from one type of radar to the next, it is not within the scope of this paper to present specific application details except to note that auxiliary data tracks are available for this purpose. The two audio channels previously mentioned as having bandwidths of 10 and 6 kc, respectively, in the standard system description are capable of handling a number of 60-cycle or 400-cycle synchro data channels simultaneously through the utilization of multiplex techniques normally applied to conventional recorders.

In other cases where azimuth and elevation information is made a part of the video signal — by means of pulse space modulation, for example — the composite signal is of course directly placed and recovered on the video channel.

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Transistors in Video Equipment

By P. B. HELSDON

Principles involved in the design of video current amplifiers for television using transistors are discussed in terms of the hybrid- π equivalent circuit. The importance of the current gain bandwidth factor is emphasized and a design philosophy which exploits an unconventional concept of gain-bandwidth is presented. An investigation of noise with regard to camera head amplifier design gives the transistor parameters and circuit conditions necessary for maximum signal-to-noise ratio. Experimental confirmation shows transistors to be comparable with valves in this application.

Vidicon Head Amplifier

Transistor circuits can sometimes be developed using ideas directly derived from conventional valve techniques. Experience usually shows that better results can be achieved by developing new methods, suited to the special properties of transistors. Transistor video amplifiers, for example, can be built using essentially valve methods, but the results are likely to be disappointing and expensive. The purpose of this paper is to find the most economical way of using transistors to obtain the high gain, wide bandwidth and low noise required for a vidicon camera head amplifier. A vidicon camera tube is a current generator, and therefore requires a current amplifier, the gain required being about 45,000 times over a bandwidth of say 5 mc/sec.

Natural Response

Current gain is most conveniently obtained using cascaded ground-emitter stages. In this configuration the inherent low-frequency current gain of a transistor is usually in the range 20 to 200 times. At high frequencies the gain falls, closely following a simple RC-type law, in which two characteristic frequencies can be defined. The first is the natural cutoff frequency f_{ac} , at which the current gain has fallen 3 db. Above f_{ac} the gain eventually falls 6 db per octave, so that the product of gain and frequency becomes a constant and defines the second characteristic frequency f_1 . This is the point at which the current gain would fall to unity, if the 6 db per octave law were truly maintained down to unity gain. Since in video amplifiers we require gains well above unity, this definition of the gain bandwidth factor f_1 is valid.

Conventional Design

The stage bandwidth required for television is greater than the natural cutoff frequency of present-day transistors, so that some artificial way must be

found for increasing it. With a pentode valve, gain can be exchanged for bandwidth simply by changing the coupling resistance. The product of gain and bandwidth remains constant. This would also be true in the transistor case if it were not for the extrinsic base resistance $r_{bb'}$. Figure 1 shows the hybrid- π equivalent circuit, with a signal source represented by a current generator. Also shown is a coupling resistor R_c and a load R_L . For the moment, assume the load to be small, so Miller effect can be neglected. It will be seen that R_c reduces the effective resistance acting in parallel with the base storage capacitance, thus reducing the input time constant, and hence increasing the bandwidth. At the same time, the gain is reduced, because some of the signal input current now flows into R_c . If, for example, the stage bandwidth required were twice f_{ac} , then the sum of R_c and $r_{bb'}$ would have to be made equal to $r_{b'e}$, but then less than half the signal current would flow into the transistor, because the sum of $r_{bb'}$ and $r_{b'e}$ would be greater than R_c . In the limit, if R_c were made zero, the bandwidth would still be finite, but the gain, zero. In other words the gain-bandwidth product falls, as the bandwidth is increased by reducing R_c . Loss of gain bandwidth in this way is inevitable when the conventional valve amplifier design method is applied to transistors, particularly when the bandwidth required exceeds two or three times f_{ac} .

Miller Effect

It can be shown that Miller effect emphasises this loss in gain-bandwidth in two ways, firstly by a reduction in the effective value of f_1 and secondly by an

increase in the adverse influence of the extrinsic base resistance $r_{bb'}$.

Cascade Loss

When stages having a simple RC-type response are cascaded, and the overall bandwidth maintained by reduction of individual-stage gains, it is well known that the overall gain passes through a maximum for a finite number of stages. The overall gain obtainable is very limited when stages having low initial gains are used.

The design calculations necessary to apply the conventional approach are formidable in any but the simplest cases. If the adverse influence of the extrinsic base resistance, Miller effect and the cascade loss are taken into account in the design of a vidicon head amplifier, for example, one would almost certainly need the services of a computer, backed up by the usual crystal ball.

New Design Method

The waste of signal current in R_c and some of the design difficulties can be avoided by a new design method. In this, the first object is to obtain all the intrinsic current gain available at the highest frequency of interest f_p . Current gain at lower frequencies is inherently larger and must be equalised by some method which does not reduce the gain at f_p .

If R_c is not to reduce the gain at f_p , it is obvious that its effective value at f_p must be made much larger than the input impedance of the transistor at that frequency. There are two ways in which this can be achieved. One is simply to use a large resistance; the other is to use a lower resistance in series with a parallel tuned circuit, resonant at f_p . A low value of real resistance may be convenient for d-c feed purposes, but a high value gives less distortion. Flexibility in the choice of coupling resistor, is one of the advantages of this design method.

Equalisation

Excess current gain at low frequencies must be equalised without reducing the

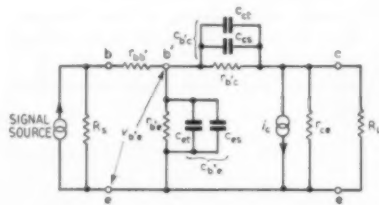


Fig. 1. Hybrid- π equivalent circuit.

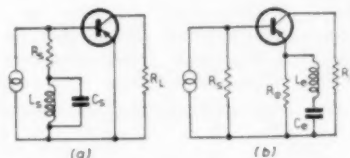


Fig. 3. (a) Equalisation using a low value R_b ; (b) equalisation employing emitter circuit feedback.

Abridgment of a paper in *J. Brit. IRE*, 19, No. 12: 753-768, Dec. 1959, by the author, P. B. Helsdon, Television Labs, Marconi's Wireless Telegraph Co., Ltd., Pottery La., Chelmsford, Essex.

gain at f_p . If the amplifier consists of only one or two stages, the low-frequency gain per stage can be made either 3 or 1.5 db, respectively, above the high-frequency gain. But in a multistage amplifier it is better to make the low-frequency stage gain equal to that at f_p . To a rough approximation the overall gain-bandwidth is then the product of all the individual stage gains at f_p times f_p itself. It will be seen that there is no limit to the number of stages that can be used, since stage gains do not have to be reduced on cascading.

Two ways are shown in Fig. 3*, by which the low-frequency gain can be equalised. Figure 3a shows a low value R_e used in conjunction with a resonant circuit. Here R_e is chosen to give the required low-frequency gain. The optimum values for the inductance and capacitance are best found experimentally; the resonant frequency is usually just above f_p . The capacitor can be removed, with only a slight loss of gain-bandwidth. The circuit is then, of course, almost identical to the conventional one, using a shunt peaking coil, and the result can be no better. The advantage then lies only in the ease of design using this approach.

The most useful method of equalisation is shown in Fig. 3b. This uses an emitter feedback resistance R_e and a large value R_b . These, incidentally, reduce distortion. A series tuned circuit, again resonant at f_p or just above, is connected across R_b to restore the initial situation at f_p . The values of inductance and capacitance are also best found experimentally. If C_e is used alone, the gain-bandwidth product falls only a small amount, and the required capacitor value can be calculated by using the maximally flat criteria.

Figure 4 shows the use of a reactance transformer. By a proper choice of inductance and Q , the stage frequency response can be extended, while maintaining a reasonably flat response at medium frequencies.

Low-Frequency Response

Field frequency square wave response is maintained in basically the same way in both transistor and valve amplifiers.

* Figures 2 and 6 are omitted.

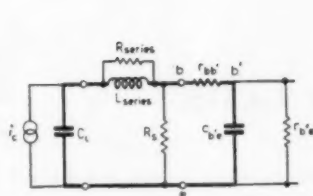


Fig. 4. Reactance transformer coupling.

The main difference is the much lower input impedance of transistor stages, which is often comparable with the previous interstage coupling resistor. As in valve amplifiers, some low-frequency compensation can be achieved by suitable choice of the decoupling network feeding the previous collector.

Noise

Noise reduction is a major problem in camera head amplifier design. Transistors produce two types of noise, each with a characteristic spectrum. The very low frequencies are dominated by the excess or surface noise, which has a spectrum inversely proportional to frequency. In a television camera, noise at the lower audio frequencies can almost be eliminated by the usual error-correcting clamp, so excess noise can be neglected.

L. J. Giacoletto has shown (Fig. 5) that white noise sources can be represented by four uncorrelated generators. Also shown is a vidicon and its load resistor with their associated equivalent noise sources.

The extrinsic base resistance produces simple thermal noise. Shot noise is generated by the flow of base and collector current and is also associated with the transfer mechanism.

Optimum Emitter Current

To make a direct comparison of signal and total noise, it is convenient to refer each equivalent noise source back to the input of the amplifier. The expression for total noise obtained in this way shows there to be an optimum emitter current which gives minimum noise. With presently available transistors, this optimum emitter current is a function of amplifier bandwidth, current gain, transit time of current carriers through the

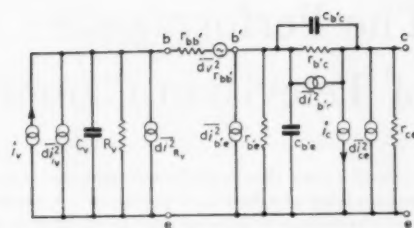


Fig. 5. First stage noise sources.

base region, and the fixed capacitances associated with the junction barriers, and the vidicon signal electrode.

Transistor Characteristics Required

Evaluation of the terms of the resulting optimal noise equation shows that to get minimum noise, a transistor should be chosen which has small values, for base transit time, barrier capacitances, saturation currents and extrinsic base resistance. Also the circuit should be arranged to minimise stray capacitances, and the vidicon load resistance should be large compared with twice r_{be} . There also appears to be a very shallow optimum value for current gain, well above present values. In practice, normal gains in the range 30 to 100 give noise figures within 1 db of the optimum.

Amplifier Performance

An experimental amplifier using type 2N345 transistors, was built to measure noise under these optimal conditions. It was designed to give a gain of 100,000 over a 5 mc/sec bandwidth. The required 1st stage transistor parameters had previously been measured and gave an optimum emitter current of 51.8 μ amp. Substitution in the noise equation predicted a signal-to-noise ratio of 42.3 db. The measured figure was 43 db. It is interesting to note that this is identical to the figure obtained with an earlier 6BQ7A valve head amplifier. Also the power consumption of this valve amplifier was 27 $\frac{1}{2}$ w, whereas the experimental transistor amplifier consumed only 300 mw.

Acknowledgment

The author wishes to thank B. N. MacLarty, Engineer-in-Chief of Marconi's Wireless Telegraph Co. Ltd., for permission to publish this paper.

The Performance of Television Camera Lenses

By GORDON H. COOK

It is well known that optical aberrations are unavoidable in lens systems and that the suitability of a lens for a particular application is dependent on the extent of these aberrations and the manner in which they are balanced. The optical requirements for television can be well defined and it is worth while to design lenses specifically for television purposes. The advantages so obtained can only be expressed qualitatively by test methods which are based on these special requirements.

Although the art of lens design and manufacture has developed very considerably in recent years, it is still a fact that any lens of the type used as a photographic or television camera objective is far from being perfect.

The unavoidable presence of optical aberrations, and to a smaller degree the wave nature of light, sets a limit to the information-carrying capacity of the system and this limit differs according to the type of information present in the subject being viewed and also according to the type of information that can be accepted and recorded by the emulsion or television channel.

In some circumstances high resolving power, or the ability to record very fine detail, will be required in both lens and channel. Alternatively, high resolution may not be present in the subject or may not fall within the information-carrying capacity of the channel. Definition of the sharpness of single image boundaries then becomes much more important than resolution.

The assessment and effects of these unavoidable lens aberrations have been the subject of considerable investigation in the past and they are well described in the available literature. The bibliography is extensive and the references listed include but a small selection of material read during preparation of the present paper.

Theoretical vs. Practical Approach

In considering the available literature, it is important to appreciate the diversity of interest that the subject provokes. There is the purely theoretical approach where the physicist or mathematician has found the subject to have considerable academic interest and the treatment is prepared on that basis. An alternative approach comes from the lens manufacturer who has a new product to describe and is more often concerned with the way in which a result is achieved rather than the way in which his product

is assessed by the user. These approaches tend to encourage complex and diverse methods of presentation which are seldom understood by the user, who may know less about the optics of his lens than about the electronics of his camera.

The author's object in presenting this paper is to give a simple summary of the known basic principles affecting the performance of television camera lenses so that a number of new lenses can be described with reference to practical and easily understood criteria. The present relationship between manufacturer and user can be improved by better terms of reference and this paper suggests that there is no valid reason why simplicity need detract from usefulness.

In the absence of knowledge regarding the magnitude of the aberrations that are present, the user often assumes that the departures from perfection are small and that a high merit rating for resolving power implies a high rating for sharpness. With lenses of the type being considered, this is not a valid assumption and resolution and sharpness must be considered as two distinctly different facets of lens performance.

Relatively, it is a simple matter to obtain a qualitative assessment of the resolving power of an optical system and this is probably the reason why this criterion enjoys a popularity out of all proportion to its true value as a figure of merit for lens performance.

Resolving power, however, is no more than a measure of the finest detail that the lens can resolve. In many cases the quality of the image for definition and sharpness at the limit of resolution is so poor that prior knowledge of the shape of the test object is required in order to recognize that resolution is present. It provides no information at all regarding lens performance at lower levels of resolution and cannot give any indication of image quality within wide variations of subject structure and in the presence of a limiting transmission system.

Performance Criteria

It would in fact be a retrograde step if any camera lens were designed to yield high resolution without any regard for other criteria of performance. This is

particularly the case in television, where the limited information-carrying capacity of the transmission channel sets such a severe limit on the fine resolution transmitted that almost any lens, judged on its resolving power alone, might appear perfectly adequate for the purpose.

The television limit on resolution is, in fact, considerable in relation to that occurring in photography. In the case of the U.S. 525-line system, 525 lines are transmitted thirty times a second, so that the time duration for scanning one line is $1/(30 \times 525)$ sec, or 63.5 μ sec. From this must be subtracted 10 or 11 μ sec for retrace blanking, leaving about 53 μ sec for the duration of one picture line. Multiplying by the bandwidth of the transmission channel gives the maximum number of picture element cycles which can occur along each line. A 4.2-mc transmission gives a maximum of 4.2×53 , or 223 pairs of black and white picture elements along each line. The length of the picture line in image-orthicon cameras is about 32 mm, so that the horizontal limiting resolving power is about 7 lines/mm. This is often called the limiting spatial pattern frequency.

In the vertical direction across the lines, the limiting resolution is set by the number of active interlaced lines and the vertical dimension of the picture format; 485 active lines yield 242 pairs of black and white picture elements over the image-orthicon format height of 24 mm. The vertical limiting resolving power is thus 10 lines/mm.

Due to the inherent effects of line scanning, the horizontal resolution is different in nature from the vertical resolution and can be considered as optically more significant. The British 405-line system has equal horizontal and vertical resolution at a limit of 8 lines/mm, and the adoption of this value in the descriptions that follow can be assumed to be equally valid for the American system.

The inadequacy of resolving power as an assessment of television lens quality can be demonstrated by simultaneously projecting images of a resolution test object obtained with two lenses. The lenses are similar camera lens, one of which has been modified in a simple way to yield a different balance of the optical aberrations present. It will be seen that one lens will resolve finer detail than the other, while it yields a more pronounced loss of contrast in the reproduction of the coarser line patterns. If we assume that the television channel limits the trans-

Presented on May 8, 1959, at the Society's Convention in Miami Beach by Gordon H. Cook, Lens Design Dept., Taylor, Taylor & Hobson Ltd., Stoughton St., Leicester, Eng.
(This paper was first received on May 13, 1959, and in final form on May 17, 1960.)

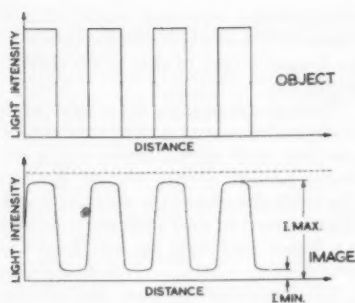


Fig. 1. Object and image light distribution curves (square wave). $M = (I_{\max} - I_{\min}) / (I_{\max} + I_{\min})$.

mitted resolution to a level corresponding to an intermediate region of this pattern, it is apparent that the second lens will yield superior results in spite of its lower resolving power. The conventional method of assessing lens performance in terms of resolving power can provide no useful information regarding the quality of a lens intended for television purposes.

This type of test object is shown at the top of Fig. 1. Plotting light intensity against distance produces a square-wave pattern and this type of object is usually referred to as a square-wave object. The image formed by the lens will not be an exact replica of the object, due, partly, to the effects of the wave nature of light, and, to a greater degree, to the effects of optical aberrations. The distribution yielded by the lens will inevitably show rounding of the corners and the contrast ratio or modulation will be reduced in the manner indicated at the bottom of Fig. 1. The light modulation in the image is expressed as

$$M = \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$$

and the values obtained in this way for a range of pattern frequencies from zero up to the cutoff frequency of the system give figures of merit for lens performance which are far more applicable to television than resolving power.

Methods of Testing

One objection to this method of testing is that it gives only a value for peak modulation and pays no regard to the slope of the gradient between the light and dark areas or to the shape of the shoulder and toe of the light distribution curve. It is conceivable that lenses having the same peak modulation to square-wave objects could yield different light distributions in the image and thus a different impression of picture sharpness.

This difficulty can be avoided by utilizing test patterns which have a sinusoidal light distribution as shown at the top of Fig. 2. Although peak modulation in the image will vary according to the magnitude of the optical aberrations present, the shape of the light distribution curve

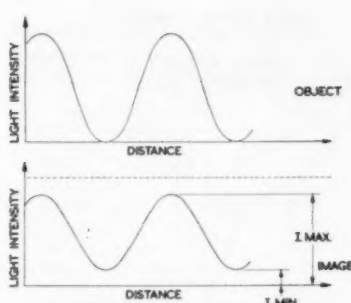


Fig. 2. Object and image light distribution curves (sine wave). $M = (I_{\max} - I_{\min}) / (I_{\max} + I_{\min})$.

in the image always remains sinusoidal. Reduction of peak modulation is thus the only effect of optical aberration and the permanence of the general shape of the distribution curve has considerable mathematical interest.

Figure 3 shows how it is possible, for example, to synthesize a square-wave pattern and consider it as made up of a fundamental sine-wave frequency plus a number of harmonic sine-wave frequencies. Lens response to a range of sine-wave test pattern frequencies can then be used mathematically to obtain more complete information regarding the distribution of light intensity in the image.

Response or peak modulation when the test pattern has a sinusoidal intensity distribution is therefore of even greater value to both the television engineer and the optical manufacturer.

If we now project images of sine-wave test objects obtained with the same two lenses, it will be seen that the lens with the lower limiting resolving power again gives the greater peak modulation of the frequencies that can be transmitted by the channel.

The eye is not particularly sensitive to changes of light intensity under these viewing conditions and the difference between the two lenses is shown in Fig. 4 which plots the response of each to a range of sine-wave test pattern frequencies. The response of lens A is

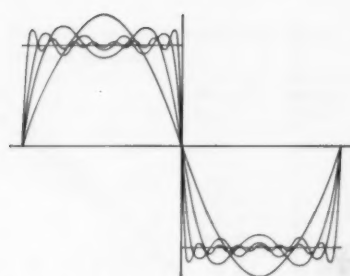


Fig. 3. Synthesis of square-wave patterns.

significantly better up to the cutoff frequency of the channel while lens B has useful characteristics only at levels of frequency which are of no interest in television.

In simple terms, the optical difference between the two lenses is that the aberration in lens A has been balanced so that the aberration fringe surrounding the image of a point object is high in intensity but small enough in magnitude to yield high modulation at low-frequency levels. Lens B on the other hand, has aberration balanced in such a way that the aberration fringe is large in magnitude but low enough in intensity not to destroy the high resolution yielded by light passing through the narrower apertures of the lens. The large low-intensity fringe merely reduces contrast or modulation at all frequency levels.

Considering the range from zero frequency up to the cutoff frequency of the television system, it is the integrated area under the curve relating response to frequency which is important. The ratio between this area and the maximum possible response shown as a dotted rectangle, has a very close relationship with the slope of the light distribution gradient at single image boundaries and thus has a linear relationship with the subjective impression of picture sharpness. This ratio can be defined, therefore, as the sharpness factor.

In Fig. 4, the shaded area under the curve for lens A is about 0.9 of that of the complete rectangle and the area under

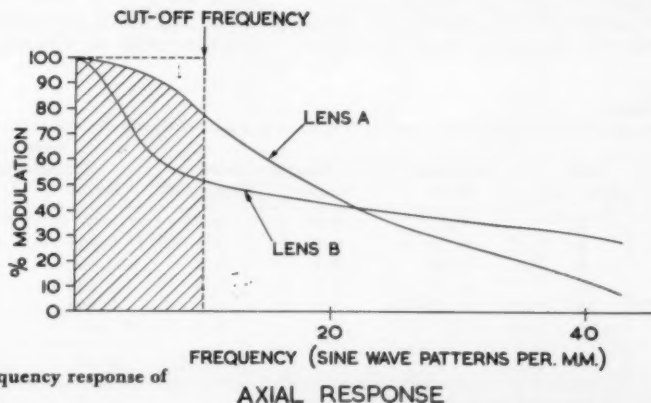


Fig. 4. Frequency response of two lenses.

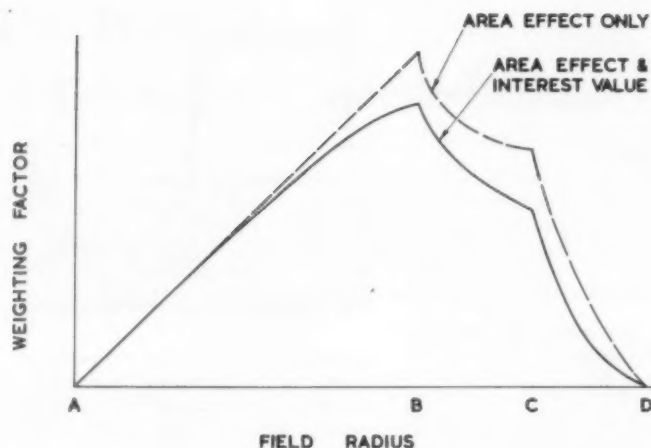


Fig. 5. Field weighting factors.

the curve for lens B is about 0.7. The sharpness factors of these lenses for an image position in the center of the picture format are said to be 0.9 and 0.7, respectively. In what follows, sharpness factor at one image position is defined in this way.

A further advantage in the use of test patterns having a sinusoidal light distribution is that the overall performance of the complete system comprising lens, camera and transmission channel, can be considered as the product of the response of all three components when these are expressed in terms of response to sine-wave test patterns. There is no possibility at all of making this overall assessment when the quality of the lens is only known in terms of resolving power and the assessment can only be approximate if square-wave response is being considered.

Performance Assessment

The full assessment of the performance of a TV camera lens may be expressed in the form of several sets of curves similar to those already shown. These should describe the response of the lens to a range of pattern frequencies at various relative apertures and at various points in the field of view. Different orientations of the test pattern are also necessary to determine lens response at image boundaries

radial and tangential with respect to the lens axis.

The correct assessment of many curves of this nature calls for expert knowledge and experience and the average user would hesitate to compare the relative merits of different lenses on this basis.

A general indication can be obtained by finding the sharpness factor in the manner described for a number of points in the field of view. These values are then integrated with respect to a field which is weighted according to the picture area corresponding to each angular field position and which has a further supplementary weighting giving the central areas a higher "interest" value than the periphery. This yields an overall factor for the whole picture format. The method has the advantage of simplicity in defining performance by a single figure of merit and gives satisfactory agreement with observed television results.

The field weighting factors utilized in the assessments that follow are shown as a whole line in Fig. 5. The dotted line plots the picture area corresponding to angular field position as a function of the field radius. This is equivalent to describing the rectangular picture format by means of a series of annuli of increasing radius. The whole line combines these area effects with the allocation of a fur-

ther arbitrary weighting which reduces "interest" value in the extreme corners of the format to 50% of that in the central areas.

There is zero area for the central point of the field shown at A. The area is likewise zero at D corresponding to the extreme corners of the picture format. The discontinuities in the curve at B and C correspond to field radii equal to half the height and half the width of the format.

The numerical scale of the vertical ordinate showing weighting factor is chosen so that the sum of the weighting factors for each of the field positions assessed is 0.5. Since sharpness must be determined for both radial and tangential patterns, the sum of the weighting factors for both orientations becomes unity and thus restores the condition that perfect imagery corresponds to an overall sharpness factor of unity. In what follows the overall sharpness factor is defined in this way.

For example, suppose that a lens to cover an image format diagonal of 40 mm is assessed for sharpness at five equally spaced image positions. The field weighting factors at these points can be given values of 0, 0.07, 0.13, 0.18, 0.12 and 0. The overall sharpness factor for this lens can be computed from the sharpness factors at each image position in the manner shown in Table I.

An interesting illustration of the usefulness of this method of assessment can be made by listing, in Tables II and III, the overall sharpness factors for two new ranges or image-orthicon and vidicon camera lenses.

Four focal lengths are selected from each range for direct comparison with the zoom lenses whose assessment follows. The Vidicon lenses are the vidicon camera lenses described in an earlier paper.¹ The Orthal lenses form part of a new range of image-orthicon lenses not yet described in detail.

The linear dimensions of the image-orthicon and vidicon picture formats are in the relationship of 2.5:1 so that the limiting spatial frequency or resolution used in the assessment of vidicon lenses is increased from 8 to 20 patterns/mm. The same factor converts inches to centimeters so that the range for each format represents the same range of angular fields of view.

When the response to a range of sine-wave test patterns is also known for the two types of camera channels, a similar sharpness factor can be computed and the product of lens and camera sharpness gives a good assessment of overall picture quality in each case.

Table IV shows similar performance figures for the orthicon and vidicon versions of the Studio Varotal zoom lens.² The sharpness factors remain at a high level throughout the focal ranges and

Table I.

Field radius, mm	Weighting factor	Sharpness factor		Weighted sharpness factor	
		Radial	Tangential	Radial	Tangential
0	0	0.9	0.9	0	0
4	0.07	0.8	0.8	0.056	0.056
8	0.13	0.7	0.6	0.091	0.078
12	0.18	0.6	0.5	0.108	0.090
16	0.12	0.5	0.5	0.060	0.060
20	0	0.4	0.3	0	0
TOTAL				0.315	0.284

Overall sharpness factor $0.315 + 0.284 = 0.6$

Table II. Image-Orthicon Overall Assessment.

Lens	Relative aperture	Sharpness factor
2-in. f/2.0	f/2.0	0.92
Ortal	f/2.8	0.95
3-in. f/2.0	f/2.0	0.92
Ortal	f/2.8	0.95
5-in. f/2.8	f/2.8	0.97
Ortal	f/4.0	0.98
8-in. f/4.0	f/4.0	0.92
Ortal	f/5.6	0.96

indicate that performance is not significantly worse than that of fixed lenses of the same range of focal lengths.

Assessment of a lens in terms of overall sharpness factor gives a straightforward and simple figure of merit for general performance but it does not give any guidance on the subjective effects of differing lens performance or on the establishment of satisfactory standards of acceptance.

In order to include these subjective effects in lens assessment, the British Broadcasting Corporation has taken the above type of assessment a stage further. It is likely that these BBC standards will become established in the United Kingdom and their description is included in this paper for the sake of completeness.

It has been found that when lenses are compared on camera channels of full information-carrying capacity, a reduction of 11% in sharpness factor can be perceived by 50% of the observers and 50% are unaware that a change has been made.

A difference in sharpness factor of 11% is said to be 1 liminal unit. The zero liminal unit rating corresponds to the performance of the theoretical perfect lens yielding perfect imagery and a lens rated down from zero to minus 1 liminal unit is thus just distinguishable from the theoretical perfect lens. Similarly, a lens rated at minus 2 liminal units is more easily distinguishable from the perfect lens and can just be recognized as inferior to a lens rated at minus 1 liminal unit.

The assessment of the lens for the effects of vignetting of oblique beams of light and thus for uniformity of image illumination throughout the picture format can be made in a similar manner and again expressed in liminal units. The zero liminal unit rating corresponds to completely uniform illumination and a down rating of 1 liminal unit corresponds to a lens yielding a level of illumination in the corner of the picture format approximately 63% of that in the center. A more rigorous treatment of liminal unit ratings is given in two papers by Sproson.^{3,4}

Sharpness and vignetting are, of course, quite different aspects of lens performance and each requires separate consideration. When comparing lenses of

Table III. Vidicon Lenses Overall Assessment.

Lens	Relative aperture	Sharpness factor
2-cm f/1.7	f/1.7	0.79
Vidital	f/2.8	0.90
3-cm f/1.4	f/1.4	0.81
Vidital	f/2.0	0.90
5-cm f/1.4	f/1.4	0.82
Vidital	f/2.0	0.94
8-cm f/1.4	f/1.4	0.82
Vidital	f/2.0	0.87

similar sharpness, however, it is permissible to add the liminal unit ratings for sharpness and vignetting to find a single figure of merit for each lens. In all cases it is important that the two parts from which this figure is constructed should be specified as separate values.

Adopting this simple type of merit rating, the assessment of these same lenses is shown in Tables V, VI and VII. In the orthicon range, the lenses are rated at less than 1 liminal unit for sharpness at full aperture, so that they should be indistinguishable from the perfect lens under all conditions of use.

The lower rating of the vidicon lenses is due to their wider relative aperture and the higher limiting spatial frequency of the vidicon channel, but at one stop below maximum aperture they fall within 1 liminal unit and are then indistinguishable from the perfect lens. The ratings for the Studio Varotal zoom lenses are particularly interesting since they show quite clearly that it is possible to produce lenses of this type which are also beyond criticism for image quality.

The high standards achieved in all these lenses indicate the advantages to be gained from giving considerable attention to the special and well-defined requirements of television and to the design of lenses specifically for this purpose. The use of electronic computers not only permits more thorough design pro-

Table IV. Studio Varotal Zoom Lens Overall Assessment.

	Focal setting	Relative aperture	Sharpness factor
Image-Orthicon Version	2½ in.	f/4.5	0.88
		f/5.6	0.92
	3 in.	f/4.5	0.87
		f/5.6	0.92
	5 in.	f/4.5	0.92
		f/5.6	0.93
	8 in.	f/4.5	0.93
		f/5.6	0.93
Vidicon Version	2½ cm	f/1.8	0.87
		f/2.8	0.92
	3 cm	f/1.8	0.87
		f/2.8	0.92
	5 cm	f/1.8	0.88
		f/2.8	0.92
	8 cm	f/1.8	0.88
		f/2.8	0.92

Table V. Image Orthicon: Overall Assessment in Liminal Units.

Lens	Relative aperture	Sharpness	Vignetting	Total
2-in. f/2.0	f/2.0	-0.7	-1.3	-2.0
Ortal	f/2.8	-0.5	-0.9	-1.4
3-in. f/2.0	f/2.0	-0.7	-0.1	-0.8
Ortal	f/2.8	-0.5	-0.1	-0.6
5-in. f/2.8	f/2.8	-0.3	-0.1	-0.4
Ortal	f/4.0	-0.2	-0.0	-0.2
8-in. f/4.0	f/4.0	-0.7	-0.0	-0.7
Ortal	f/5.6	-0.4	-0.0	-0.4

Table VI. Vidicon Lenses: Overall Assessment in Liminal Units.

Lens	Relative aperture	Sharpness	Vignetting	Total
2-cm f/1.7	f/1.7	-1.9	-0.0	-1.9
Vidital	f/2.8	-0.9	-0.0	-0.9
3-cm f/1.4	f/1.4	-1.7	-0.6	-2.3
Vidital	f/2.0	-0.9	-0.0	-0.9
	f/2.8	-0.7	-0.0	-0.7
5-cm f/1.4	f/1.4	-1.5	-0.0	-1.5
Vidital	f/2.0	-0.5	-0.0	-0.5
	f/2.8	-0.5	-0.0	-0.5
8-cm f/1.4	f/1.4	-1.6	-0.0	-1.6
Vidital	f/2.0	-1.2	-0.0	-1.2
	f/2.8	-0.7	-0.0	-0.7

Table VII. Studio Varotal Zoom Lens Overall Assessment in Liminal Units.

	Focal setting	Relative aperture	Sharpness	Vignetting	Total
Image-Orthicon Version	2½ in.	f/4.5	-1.2	-0.4	-1.6
		f/5.6	-0.7	-0.0	-0.7
	3 in.	f/4.5	-1.2	-0.4	-1.6
		f/5.6	-0.7	-0.0	-0.7
	5 in.	f/4.5	-0.7	-0.5	-1.2
		f/5.6	-0.6	-0.0	-0.6
	8 in.	f/4.5	-0.7	-0.6	-1.3
		f/5.6	-0.6	-0.0	-0.6
Vidicon Version	2½ cm	f/1.8	-1.2	-0.4	-1.6
		f/2.8	-0.8	-0.0	-0.8
	3 cm	f/1.8	-1.2	-0.4	-1.6
		f/2.8	-0.8	-0.0	-0.8
	5 cm	f/1.8	-1.1	-0.5	-1.6
		f/2.8	-0.8	-0.0	-0.8
	8 cm	f/1.8	-1.1	-0.6	-1.7
		f/2.8	-0.8	-0.0	-0.8

cedures but also enables the designer to compute sharpness factors for alternative designs before selecting the best for the purpose. The new types of glass having extreme optical properties also have an important role in these new products. Although some of the lens constructions bear a family likeness to the older forms, they are in fact quite different. It is of interest to note that the design procedures adopted would be quite valueless in the absence of the new glasses.

Of the assessments described, sharpness factor at each single image position is the most valuable to the expert. Overall sharpness factor assesses performance over the field of view to yield a single figure of merit for the convenience of the user and automatically includes some of the processes of compromise that the expert would apply. Overall assessment expressed in liminal units is similar to the latter but includes subjective effects which are valuable in giving the figure of merit more meaning in terms of actual television performance.

Many workers in the field of television optics have contributed to a clear understanding of television lens requirements and arguments that any lens is good enough for television are now discredited. The optical industry appears to be

following these teachings with some degree of success. With regard to image sharpness, the lenses described in this paper suggest that we are now in a region of diminishing return for effort expended and further development in this direction may not yield worth-while results unless new television transmission systems are adopted.

A strong case can be made in favor of closer collaboration between television and optical engineers to bring about standardization of test methods of the type suggested. These would provide assessments which are meaningful in both fields when used to indicate the correct approach to the design and manufacture of lenses specifically for television.

Acknowledgment

Thanks are due to Taylor, Taylor & Hobson for permission to publish this paper.

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3. W. N. Sproson, British Broadcasting Corporation Monograph No. 15, Dec. 1957.
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Discussion

Garland C. Misener (Capital Film Labs., Inc.): I should like to ask Mr. Cook, if I may, if these lenses are T-stop calibrated and how the number of glass-to-air surfaces affects total transmission factors?

Mr. Cook: There is no reason why these lenses should not be calibrated in T-stops instead of f-stops, but in the European market we have found this to be unnecessary. These lenses are provided with iris mechanisms designed in such a way that a given angular rotation of iris control produces the same change of light transmission for any lens at any relative aperture. The operational advantages of a common linear iris scale for all lenses appear to outweigh those of T-stop calibration. Transmission of these lenses is held at a uniformly high level and the extra advantages to be gained from T-stop calibration are small.

A Progress Report on Television Magnetic-Tape Standardization

By C. E. ANDERSON

The SMPTE Video-Tape Recording Committee has been working since its initial meeting in June 1958 on items requiring industry standardization in order to insure interchangeability of recorded video tapes. A list of pertinent items was prepared and tasks assigned by the Chairman. The list includes tape dimensions, tape reels, tape track dimensions; audio, control and cue track standards; monochrome and color signal characteristics; tape leaders; standard tapes; tape speed, tip penetration, and tape splicing. This report covers the current status of the Committee's work and updates the report given by A. H. Lind at last year's May Convention.

THE VIDEO-TAPE RECORDING COMMITTEE was established and its first meeting held in June 1958 under the chairmanship of Howard Chinn of CBS. The Committee membership has expanded slightly in the succeeding two years until it includes a representative from each of the three major U.S. tele-

vision networks, a member from a large independent station group in the U.S., one from the Canadian Broadcasting Corp., one from each of the two equipment manufacturers, one from the principal tape manufacturer, one from the National Association of Broadcasters, one from the National Educational Television and Radio Center, and a liaison member from the SMPTE Television Committee. The NAB member circulates to and solicits comments from all television tape-equipped NAB

member stations on the proposals for standards.

Meetings have been called almost every two months during the two-year life of the Committee, the most recent one, on April 20, 1960, in New York City. This report covers the progress made and the status of work in the Committee as of that date.

After approval by the Video-Tape Recording Committee, each proposed standard or recommended practice is submitted to the SMPTE Standards Committee for review and approval. Following the Standards Committee approval it is published in the *SMPTE Journal* for three months for comment by those interested. If there are no adverse comments it is either accepted as an SMPTE Recommended Practice or submitted to ASA Sectional Committee PH22 for further processing as an American Standard. Appropriate steps

Presented for the Committee, on May 5, 1960, at the Society's Convention at Los Angeles, by C. E. Anderson, Ampex Professional Products Co., Box 3000, Redwood City, Calif. (This paper was received on June 20, 1960.)

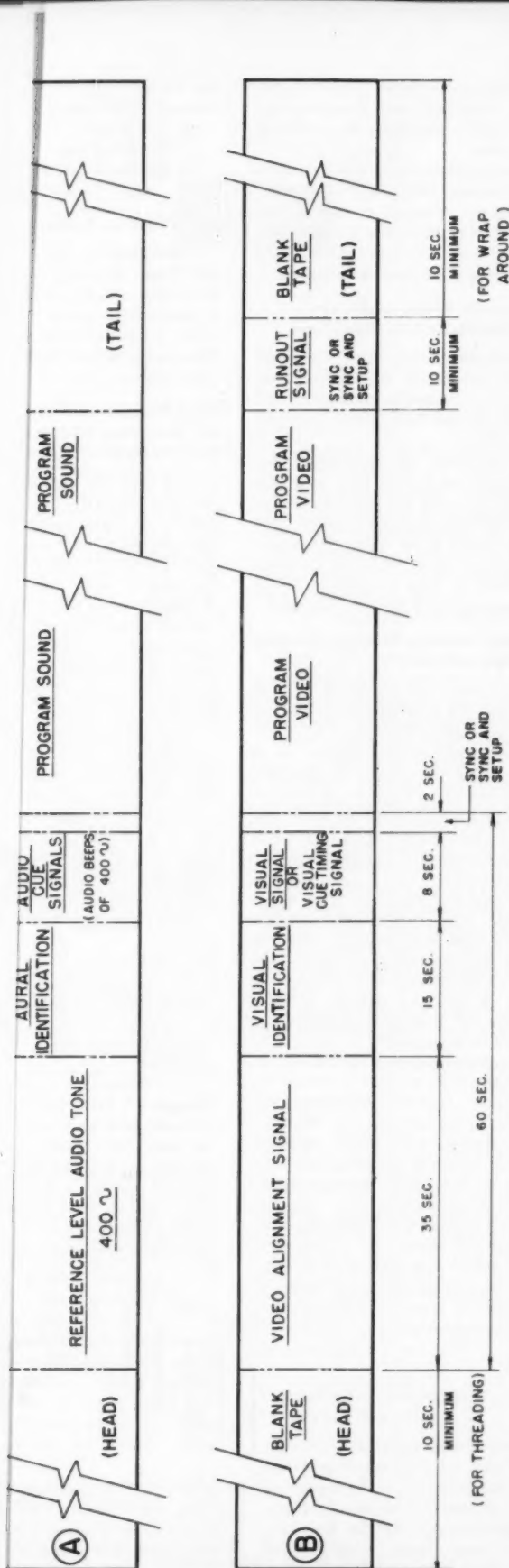


Fig. 1. Tape leader.

are taken to resolve adverse comments before the standard is adopted.

The primary objective of the Committee's work is the development of such standards as are required to assure interchangeability of television tapes. Many parameters associated with the television tape in either physical or electrical forms are involved.

Dimensions for 2-In. Video-Tape Reels

Work on the proposed standard progressed to the point where the proposal was assigned the ASA number PH22.116 and published in the SMPTE *Journal* for November 1959 (p. 770). Comments received during the trial period indicated that the proposal was too restrictive. As a result, the proposed standard was rewritten to conform as nearly as possible to EIA proposal TR24.4.2, Standard Interchangeable Reels for Magnetic Tape, differing only on three items. Such differences are necessitated by demands peculiar to television magnetic recording.

The revised proposal will be ready for resubmission to the SMPTE Standards Committee by July 1960.

Dimensions for 2-In. Video Tape

This proposed American Standard PH22.123 has been approved by the Standards Committee and was published in the April 1960 *Journal* (p. 269). The proposal provides for the following:

Width — The width of the tape shall be 2.000 in. $+0.000/-0.004$ in.

Thickness — The overall thickness of the base plus coating shall not exceed 0.0015 in.

Curvature — Curvature of the tape shall not exceed $\frac{1}{8}$ in. in 48 in. Curvature shall be measured by constraining the tape to lie in a plane under zero tension and by positioning to a 48-in. long straight edge. The maximum deviation of the tape edge from the straight edge shall be taken as the curvature.

Specifications for Monochrome Video-Tape Leader

Publication of the proposed specification, PH22.115, in the November 1959 *Journal* (p. 769) was followed by a series of suggestions from interested persons. As a result of these suggestions, a Subcommittee whose chairman was George Nixon of NBC was formed to make changes in the proposal.

Salient features of the revised proposal are shown in Fig. 1. An important addition to the leader is the 10-sec runout signal during which sync or sync-and-setup only are recorded. Following the runout signal must be at least 10 sec of blank tape.

The proposal has not been forwarded to the parent Video-Tape Recording Committee as yet, so further modifica-

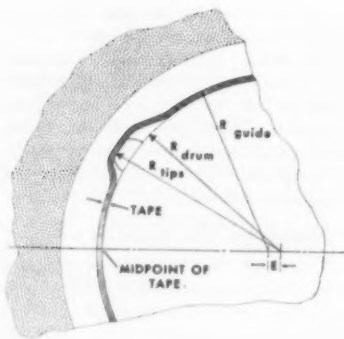


Fig. 2. Head-tape-guide relationships.

tions may be expected. The NAB is playing a very active role in the shaping of this standard.

Patch Splices in 2-In. Video Tape

This proposal has been accepted by the SMPTE as a Recommended Practice, RP5, as published in the February 1960 *Journal* (p. 118). Copies of the practice can be obtained from Society headquarters. The accepted practice differs from the proposal described in last year's report by deleting all reference to the field pulse. It was felt that once the editor has used the field pulse to locate vertical sync, personal or company preference may indicate that the splice be made at some place other than the point defined by the field pulse.

Characteristics of the Audio Records for 2 In. Video-Tape Recordings

The proposed American Standard PH22.121 for audio track recording specifies that mechanically the video-audio separation on the tape shall be 9.250 in. \pm 0.100 in. with the audio track leading. Electrically, the reproducing characteristics shall correspond to the NAB Recording and Reproducing

Standards for Mechanical, Magnetic, and Optical Recording and Reproducing; Section 2.80, Standard Reproducing Characteristic.

This proposed standard was published in the February 1960 *Journal* (p. 120). If no adverse comment is received by the end of May 1960, the proposal will be forwarded to ASA Committee PH22 for processing as an American Standard.

Dimensions for Video, Audio, and Control Records on 2-In. Video Tape

The proposed American Standard PH22.120 defines the track dimensions for the video, program audio, cue and control tracks on 2-in. video magnetic tape recordings.

Both suppliers of equipment are currently manufacturing their recorders in accordance with the proposed standard as published in the February 1960 *Journal* (p. 120). If no adverse comment is received by June 1960, the proposal will be sent to ASA Committee PH22 for processing as an American Standard.

Modulation Levels for Monochrome 2-In. Video-Tape Recording

This proposal was published in final form as SMPTE Recommended Practice RP-7 in the April 1960 *Journal* (p. 271). The form was chosen because it is realized that the most desirable operating condition would be a choice of modulation levels suitable for both monochrome and color. The present state of the art, however, dictates that separate practices are desirable.

It is hoped that suppliers of recording equipment will make improvements eventually that will allow a common standard. For this reason it was decided by the Committee to publish the proposal as a more flexible SMPTE Recommended Practice rather than as an American Standard.

The proposal provides for the follow-

ing carrier frequencies corresponding to reference video signal levels:

- (a) Tip of sync: 4.28 ± 0.05 mc
- (b) Blanking level: 5.0 ± 0.05 mc
- (c) Reference white level: 6.8 ± 0.05 mc.

Speed for 2-In. Video Tape

Subsequent to last year's report by Mr. Lind, the proposal PH22.122 was drafted in which tape speed was defined. It proposes a nominal linear speed of 15 in./sec or 960 video tracks per second. This proposal was published in the April 1960 *Journal* (p. 269).

Tape Vacuum Guide Radius and Position for Recording Standard Video Records on 2-In. Magnetic Tape

This is another proposal drafted since the last report. The maintenance of proper physical relationships between the rotating video heads and the vacuum guide within certain tolerances is a necessity if tapes are to be played on machines or heads different from the one on which they were recorded, or if tapes made on different machines are to be spliced together. If the proper relationships are not maintained, geometric distortions will be present in the reproduced pictures.

A recently developed automatic timing equalizer circuit will relieve somewhat the very rigid operational control of dimensional relationships that must be maintained to avoid geometric distortions in the reproduced picture. However, the device's correction range is finite, and it cannot be considered a substitute for proper design, careful manufacture, and correct adjustment of recording and playback machines. The need remains to establish standards and to adhere to them. The automatic correction device must be considered an aid to operation and not a substitute for standards.

It is necessary to specify three critical dimensions to eliminate geometric distortions: head pole tip radius of rotation, vacuum tape guide radius, and the position of the guide with relation to the axis of rotation of the video heads. The range of pole tip radii allowable is from 1.0356 in. maximum to 1.0329 in. minimum while the vacuum tape guide

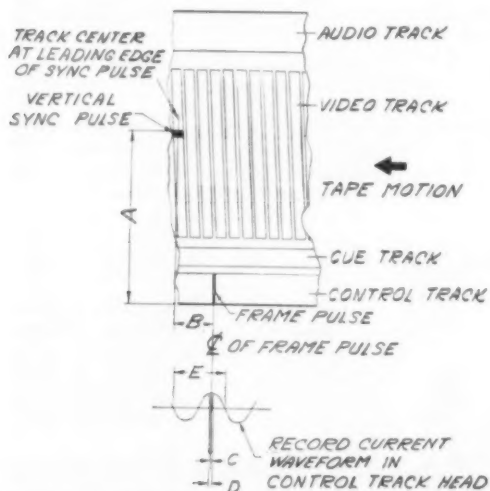


Fig. 3. Control track.

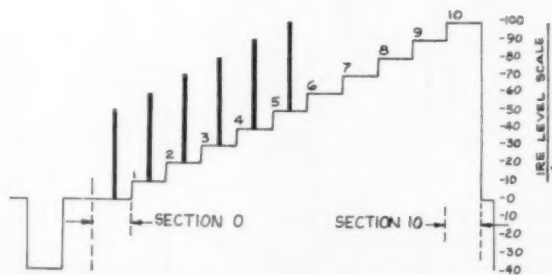


Fig. 4. Bands 1 to 4 — detail.

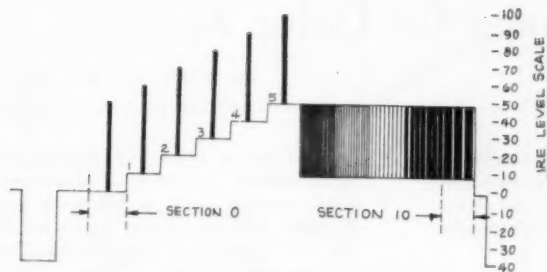


Fig. 5. Bands 5 to 8 — detail.

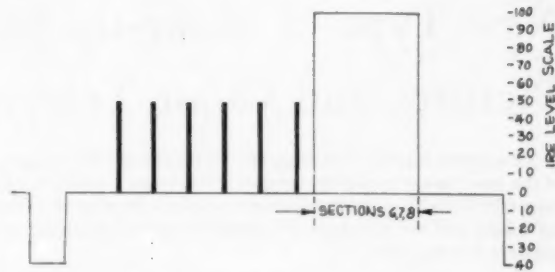


Fig. 6. Bands 9 to 15 — detail.

radius is limited to the range from 1.0329 in. to 1.0333 in.

The eccentricity between the center of curvature of the guide and the axis of rotation of the heads shall be such that the extension of a line joining the center of curvature and axis of rotation intersects the tape at the mid-point of its width. The center of curvature of the vacuum guide shall lie between the axis of rotation of the heads and the vacuum guide.

Utilizing the nominal value of vacuum guide radius, the eccentricity between the guide's center of curvature and the head's axis of rotation shall have a value of 0.0003 in. (Fig. 2).

All of the above figures assume a nominal tape thickness of 0.0014 in.

The equipment needed to adjust the relationships by direct measurement is somewhat more complex than that found in most broadcasting facilities. It is expected, therefore, that the major use of direct measurement techniques will be made by manufacturers of equipment who will use a precisely adjusted machine to produce standard tapes. The standard tapes will be supplied to broadcasters who will, in turn, be able to adjust their recorders quickly by reducing geometric distortions in the picture reproduced from the standard tape.

Control Track Record for 2-In. Video-Tape Recordings

The drafting of the proposal has proceeded slowly because of many diverse opinions held by both members of the Committee and other users. A final draft is being prepared for balloting by Committee members, and it is hoped the proposal can be sent to the Standards Committee soon.

The proposal includes dimensional relationships between the position of the recorded vertical sync pulse and the guided edge of the tape, sync and frame pulse, tracking control signal and frame pulse, frame pulse and video tracks. (Fig. 3).

It has been decided to use frame pulses rather than field pulses. The pulse shall designate the vertical blanking interval preceded by a full horizontal line. The start of vertical sync shall be

1.150 in. ± 0.10 in. from the guided edge of the tape.

The pulse shall be positioned so that the centerline of the recorded pulse shall intersect within ± 0.0005 in. at the guided edge of the tape, the extended centerline of the area between the second and third video track records after the track containing the start of the vertical synchronizing pulse.

The tracking control signal shall be so located that the point of maximum record shall coincide with the extended centerline of the area between the video track records within ± 0.0005 in. The wave shape of the tracking control signal record current is to be sinusoidal.

Prior to this proposal the phase relationship between tracking control signal and frame pulse was such that the pulse was approximately midway between the tracking control signal zero current crossover and the point of maximum current. Moving the tracking control signal so that the frame pulse occurs at maximum current and is of opposite polarity allows the pulse to be seen more easily on "developed" tape.

De-emphasis for Use With Monochrome Television Magnetic-Tape Recorders

Work has lagged on this project for a variety of reasons. It is realized that, like deviation limits, it would be best to have one standard for both monochrome and color operation. Both manufacturers of recorders have been experimenting with various amounts of pre- and post-emphasis, and one manufacturer has suggested a new curve believed to be suitable for both monochrome and color and which will yield a better overall signal-to-noise ratio.

Tapes and technical information are to be exchanged between manufacturers for comparison.

Video Alignment Signal for Video-Tape Recordings

Work on this proposal was delegated to a Subcommittee, and the Subcommittee has given a recommendation to the parent Committee. Since a rotating-head-type recorder automatically slices the television image into horizontal bands of 16 to 17 horizontal television

lines, these bands have been numbered from top to bottom for reference.

Bands 1 through 4 (Fig. 4) are to contain a composite signal consisting of a stair-step signal of 10 equal steps. On the area corresponding to blanking and on the first five steps shall be a sine-squared pulse 50 IRE units high.

Bands 5 through 8 (Fig. 5) shall for the first five steps be equivalent to the first four bands. After the fifth step, however, there shall be a multiburst signal 40 IRE units in amplitude varying about a baseline at the 30-unit level.

Bands 9 through 15 (Fig. 6) contain six sine-squared pulses which align with the first six pulses in other bands. These last pulses rise from blanking level and are followed by white window.

Both manufacturers of equipment report that they are building equipment to generate the alignment signal and it is hoped sample tapes will be available soon for evaluation by members of the Committee.

An audio tone of reference level and 400 cps in frequency shall be recorded on both audio and cue tracks. The tone shall be interrupted at one-minute intervals for voice identification of the tape.

Standards for Color Recording

As noted in the preceding text, color has not been forgotten. It is a fact, however, that with the present state of the art, color is more difficult to record than is monochrome. For the present it appears that standards will have to be separate, at least for carrier deviation. There is hope that pre-emphasis can be the same for both modes.

It has been decided to take no further action at this time in the hope that manufacturers and users of color recorders can work together and present suggestions. The matter will be reopened when enough new material has been gathered to warrant such action.

H. A. Chinn, *Chairman*

C. E. Anderson	A. H. Lind
G. W. Bartlett	N. A. L. Moore
K. B. Benson	R. M. Morris
R. J. Bowley	H. W. Town
W. K. Grimwood	R. A. von Behren
F. Himelfarb	

New Type of Make-up Material for Color Motion Pictures and Color Television

By HIDEMITSU SEKI
and AKIRA KODAMA

A full account is presented, from the viewpoint of color science, of the foundation of the new type of make-up material, "High-con," which has been manufactured on a trial basis. The spectrophotometric characteristics of natural-skin and make-up colors, and the metamerism phenomenon in the reproduction of colors in motion pictures are discussed.

THE MEMBERS of the Japan Color Research Institute were among the first to promote investigations in the production of skin-color charts. Color motion pictures have been so rapidly popularized recently that such charts are very urgently needed as the basis for investigations concerning color reproduction.

With the support of the Daiei and Toei motion-picture companies we have carried out and reported a series of investigations, which mainly consist in the examination of the problem of skin color (mostly facial color) whose color reproduction is said to be extremely unstable. The subjects of these investigations are as follows:

- (1) examination of skin colors from the spectrophotometric standpoint,^{1,4}
- (2) research concerning the vinyl skin-color charts,^{1,5}

(3) examination of skin colors by visual measurement,^{2,3,4,7}

(4) research which concerns the establishment of skin-color types,^{4,6} and

(5) research for the changes of facial color which are caused by make-up.⁷

Meanwhile, we attempted, in certain color motion pictures such as Daiei's *Gate of Hell*, *Yô-Ki-Hi*, *The Renovated Tales of Heike*, *The Night-River* and *Kiso Yoshinaka*; and such as Toei's *Âkô-Rôshi*, *The Sunset and the Revolver* and *The Rice*, various experiments in these practical fields. We cooperated in the spectrophotometric measurement of actors' skin colors (their bare faces), in the visual measurement of them, in the establishment of "The Discrimination Diagram of Skin Color Types," in the choice of make-up materials, in the measurement of skin colors after make-up and in the preparation of make-up cards.

But we noticed after these experiments that the make-up materials which are now in use in the field of color pictures, where the main difficulty lies in the

reproduction of skin colors, leave much to be desired. It seemed to us that we must examine them purely from the viewpoint of color science; consequently the main points which we decided to analyze at first were:

(1) The metamerism phenomenon which may account for the difference between the spectrophotometric characteristics of skin colors and those of make-up material, and which may be one of the causes of poor color reproduction.

(2) The best method of establishing the color range of make-up materials from the viewpoints of skin-color distribution among the Japanese, of the quality of the character in the movie in question, and of the characteristics of color sensitivity of the color film under consideration.

Note: The make-up materials of interest here are pan-stick and pan-cake, for example, and not line make-up, etc.

We attempted various experiments in relation to these two items as a result of which we manufactured on a trial basis the "High-con Color Stick," a new type of make-up material for color motion-picture use. Now we shall set forth its characteristics in detail, and shall also examine the metamerism phenomenon of the former make-up materials, their color range, etc.

NONMETAMERIC MAKE-UP MATERIAL

Spectrophotometric Characteristics of Skin Colors

The spectrophotometric character of skin colors has been thoroughly reported as cited in the references for this report;

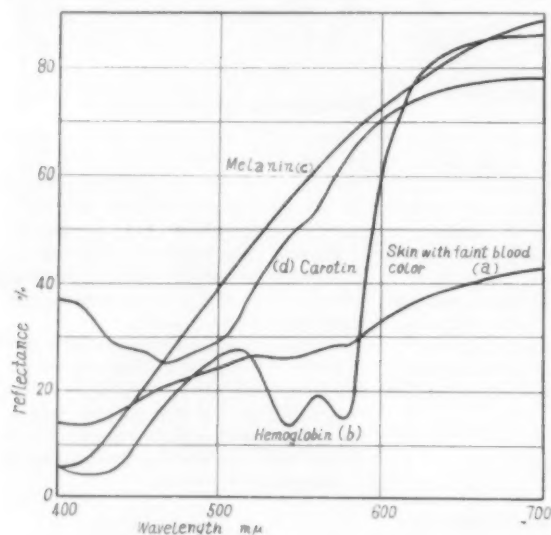


Fig. 1. The spectrophotometric characteristics of the representative component pigments of skin color. Curve (c), melanin, is reproduced from Evans' *An Introduction to Color*.³ The other curves represent measurements made in the Japan Color Research Inst.

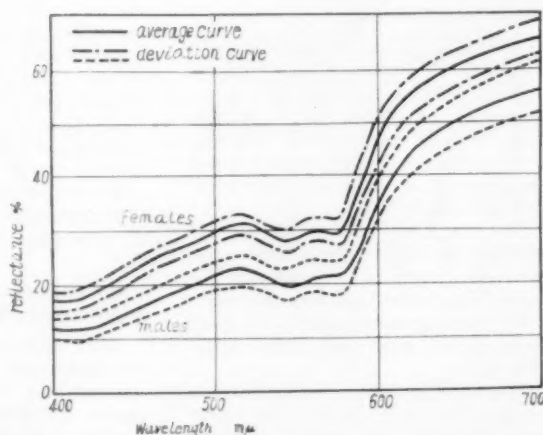


Fig. 2. The average spectrophotometric curves, and their standard deviations, for male and female actors.

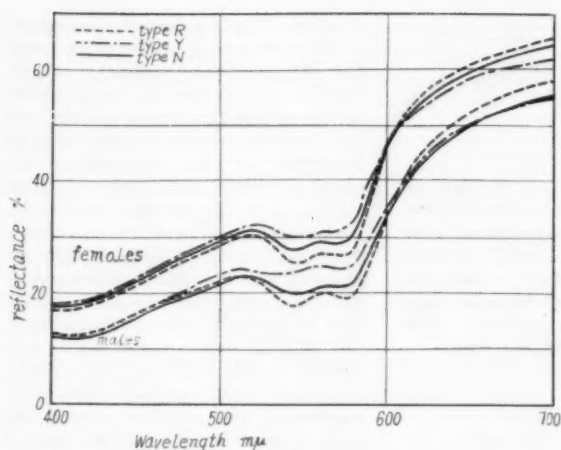


Fig. 3. Example of types R, Y and N spectrophotometric curves of actors of both sexes.

but we refer to these in order to emphasize the connection which exists between skin colors and make-up materials.

Skin colors possess semitransparency (opacity), subtle relief, gloss, hair — accessories which are composed of complicated elements from the viewpoint of "texture."

Skin color is a color which is composed of all sorts of small pigment groups which lie in the various layers of human skin. It is never a simple surface color. According to Kaneko,⁸ the component elements of skin color are classified as follows:

- (1) local color of skin (an opaque jaundice color which lies in the deep cuticle of stratum corneum),
- (2) blood color seen through the skin (the color of hemoglobin which appears red or blue),
- (3) skin pigment (brown or black melanin pigments), and
- (4) anomalous skin pigments (choleric pigment, carotin, etc.).

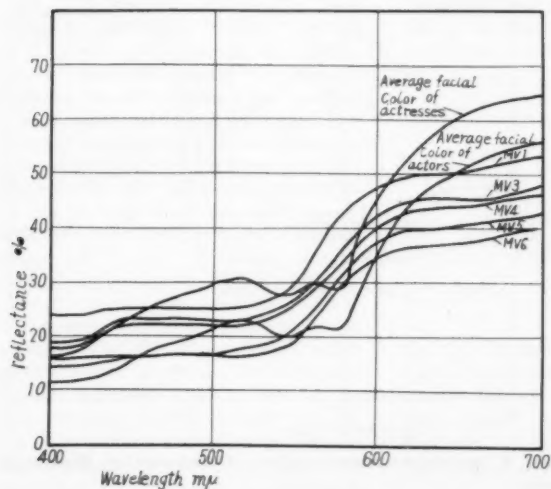


Fig. 5. Examples of the spectrophotometric characteristics of previous color motion-picture make-up materials.

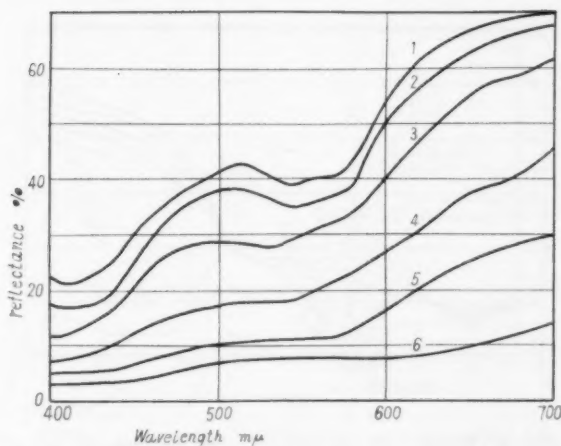


Fig. 4. Spectrophotometric characteristics of racial skin colors: (1) white blond; (2) white brunette; (3) the Japanese; (4) the Hindu; (5) Mulatto; (6) the Negro. (From Evans' *An Introduction to Color*.⁹)

The spectrophotometric characteristics of skin color are formed by the combination of several spectrophotometric curves of these color elements (Fig. 1). Figure 2 shows the average curves of representative Japanese actors' and actresses' facial colors. After these investigations one can conclude that the spectrophotometric characteristics are very clearly shown by a three-stepped curve, a relatively high reflection which occurs near the wavelength 520 mμ (almost green spectral color), an absorptive curve formed like the letter W which covers from 520 mμ to 580 mμ, and then a reflective curve above 580 mμ which seems like red color. One can conclude at once that this curve is principally influenced by the component pigment (b) (Fig. 1) of skin color. The spectrophotometric characteristics of hemoglobin are composed of a very sharp curve containing a green absorption, as shown in Fig. 1.

But as the blood lies in a relatively deep part of the skin, its characteristics are masked to various extents in various curves because of the color of skin zones (a), the other pigments (c) and (d), or the thickness of skin layers, the quantity of pigments and the density of capillary blood vessels.

The colors of the human skin may be loosely classified as "pinkish," "yellowish," "pale" or "swarthy." The many and various colors of the skin resulting from a combination of many different shades and hues may be classified under the predominant color. For the purposes of this study, skin-color types⁴ have been classified in accordance with the findings of our research on movie actors. The spectrophotometric curves, type R, type N and type Y, of both sexes are shown in Fig. 3.

Thus, the difference which lies between type R and type Y is clearly discerned by the curve of hemoglobin characteristics. Also, a man's color, compared to that of a woman, has generally low reflectance, that is to say, dark face and arms, etc. This difference of color arises from the quantity of melanin pigment. It is said that this variation of melanin pigment is responsible for racial differences of skin color. Figure 4 represents several examples of spectrophotometric curves of skin color for different races.⁹

Spectrophotometric Characteristics of Previous Make-up Materials

The color of most make-up materials is approximately that of skin color. If one examines their spectrophotometric curves, however, one finds that their forms are very simple and that no attempt seems to have been made to simulate the spectrophotometric characteristics of real skin (Fig. 5). What phenomena will arise when the

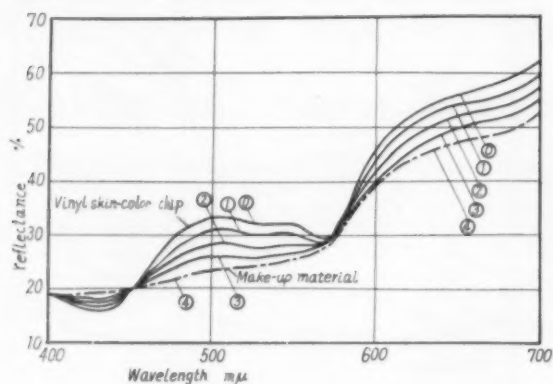


Fig. 6. Change of spectrophotometric characteristics of skin color with previous make-up material. (Vinyl skin-color chips were used in place of real skin color.)

skin is painted with the make-up material that possesses spectrophotometric characteristics significantly different from the skin color? Figure 6 shows how the spectrophotometric curves change whenever one applies the previous make-up material gradually from a thin powdering to a very thick one onto the vinyl skin-color chips which have been substituted in these studies for the real skin. According to this investigation, in the case of very thin powdering, shown in curves 1 and 2, the characteristics of skin color are still maintained, but in the thicker applications, curves 3 and 4, they are already lost and there are only the spectrophotometric characteristics of the make-up material itself.

In this way, by powdering one loses the spectrophotometric characteristics of skin color, that is to say, one loses the above-mentioned various characteristics of skin colors. So we conclude that it is desirable to approximate the cosmetics' spectrophotometric characteristics to

those of skin colors. (Of course, the influence of texture is also very remarkable; but for the present we intentionally neglect this problem.)

The Metameric Phenomenon

What we call here "the metameric phenomenon," for visually identical but spectrophotometrically different colors, may be explained as the visual appearance of two colors, equal under a particular illumination, but which seem quite different under another illumination having different light distribution characteristics.

For example, we may specify a facial color under the light from a north window (approximately light source C) and do the color matching by comparing with standard colored papers. If we change the illumination to that from a tungsten electric lamp, the skin color will seem more reddish and, in consequence, the colored paper which seemed visually equal to it will seem more

yellowish. This is a phenomenon caused by the difference of spectrophotometric distributions of the illumination and by the difference of their color temperatures. If these differences become greater, the visual difference also becomes greater. According to our experiments the visual difference was a shift of about 0.5 to 1.5 in the standard blue scale. Such tendency of hue shift occurs almost equally in the case of skin colors and the make-up material. What influence does it have upon color motion pictures? One of the most obvious examples is that when a warrior uses a wig or top-knot in a historical play, the shaven part of the head is usually finished by powdering the cosmetics onto the plain glossy silk cloth as the ground stuff (foundation). It is natural that a metameric phenomenon often occurs between this part of the wig, which is colored by the cosmetic alone, and the bare forehead, which is a mixed color composed of the make-up and the actual skin.

The make-up room of most motion-picture studios uses fluorescent illumination; consequently, for an actor wearing a wig, after complete color matching in the make-up room, a color difference naturally arises when he enters the studio in which tungsten lamps are used.

It also follows that when one must do thin make-up, unless powdering is carefully done, the unevenness of make-up material is greatly exaggerated by the metameric phenomenon. It is likely that in the case of thick powdering, as was noticed in the preceding experiment its characteristics become quite different from the real skin color, and that as a

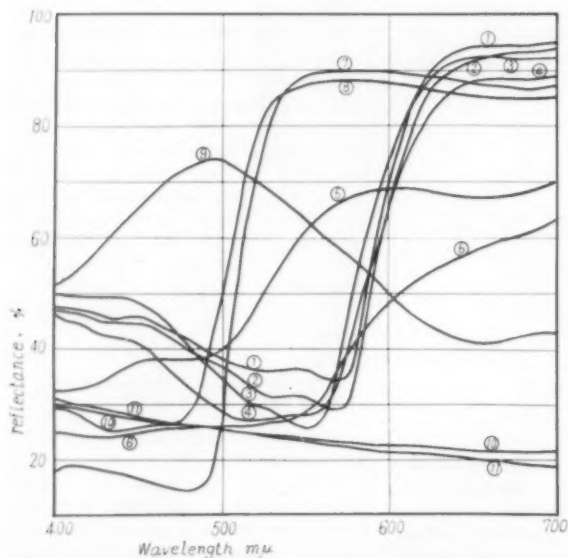


Fig. 7. Examples of spectrophotometric curves of pigments for the use of High-con: (1) to (6), red; (7) and (8), yellow; (9), green; (10) and (11), black.

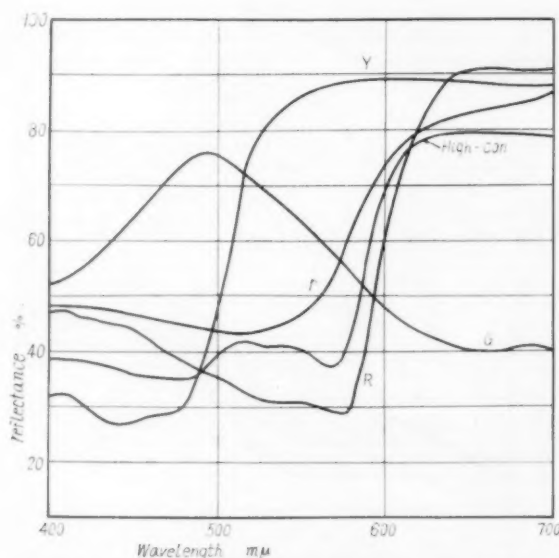


Fig. 8. Spectrophotometric curves of pigments for High-con's use.

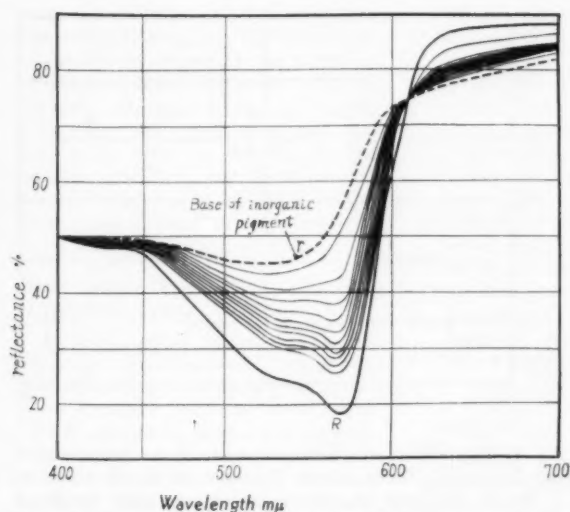


Fig. 9. Example of composition process of High-con.

result the make-up material, especially a bright one, results in a whitish, powdery appearance. Consequently, we think that the former make-up material and the metameric phenomenon go together logically.

One of the greatest obstacles to overcome in a make-up material is to exclude from the spectrophotometric composition of cosmetics the characteristic which is responsible for the metameric phenomenon that interferes with reproduction of the typical skin color.

High-con Color Stick has been manufactured on a trial basis, in accordance with the above-stated viewpoint. We shall explain the process of its manufacture in the next section.

Spectrophotometric Curves of High-con Color Stick

Figure 7 shows the examples of the spectrophotometric curves of ordinary pigments which were collected in order to choose the most ideal ones which can meet the demand of High-con Color Stick. The selected pigments are those which the Ministry of Welfare¹⁰ permits to be used in the manufacture of cosmetics. After examining the spectrophotometric characteristics of a number of red, yellow, green and black pigments and also investigating the manufacturing process, the quality of products and their adaptability under the various conditions of use of each make-up material, we selected three representative pigments which are *R* (red), *Y* (yellow) and *G* (green) as shown in Fig. 8. Usually these three pigments are suitably combined for the coloration of each make-up material. The absorptive characteristics in the vicinity of 580 $m\mu$ are composed by the absorptive characteristics of *R*. The reflection in the vicinity of 520 $m\mu$ is composed similarly by the reflective characteristics of *Y*. Figure 9 shows how the absorptive characteristics

of *R*, being deeper than necessary, were adjusted to a suitable degree by making use of the simple spectrophotometric curve of an inorganic pigment.

Figure 10 shows an example of the spectrophotometric curve of High-con which has been composed in this manner. By comparing it with the spectrophotometric curve of skin color, one finds that there remain still some faults to be amended in the characteristics that range from the short wavelength 400 $m\mu$ to 500 $m\mu$. But the reflection in the vicinity of 520 $m\mu$, the absorption in the vicinity of 570–580 $m\mu$ and the curve in the long wavelength range above 580 $m\mu$ are reproduced with such high fidelity that it can, we believe, be treated as equivalent to the spectrophotometric characteristics of real skin color.

Shown in Fig. 11 is the change of the spectrophotometric characteristics of skin color, when the new make-up material is gradually painted on the skin. (We used the skin color chips as in the preceding experiment.)

It will be seen that there is scarcely any change of characteristics from 520 $m\mu$ to 700 $m\mu$, either in the thin powdering

or in the thick. The defect of High-con in the short wavelength region, however, is likely to be serious at times, so we desire to improve it as soon as possible.

Also, as in the case of real skin colors, the characteristics are different when they are bright, dark, reddish or yellowish, and the most ideal nonmetameric make-up material should be made to vary in the same manner.

COLOR RANGE OF MAKE-UP MATERIALS

The principal purpose of make-up consists in the creation of a face, arms, etc., of an actor fitting him with the character which he acts in a drama. And the make-up material is considered an implement which controls the disparity between the actor's bare face and his character's facial color.

Since both the actor and his character are Japanese, the color of make-up materials should naturally be based upon Japanese skin colors. We know that most cosmetics which are actually in use have been modeled after skin colors; and yet, according to what we have seen

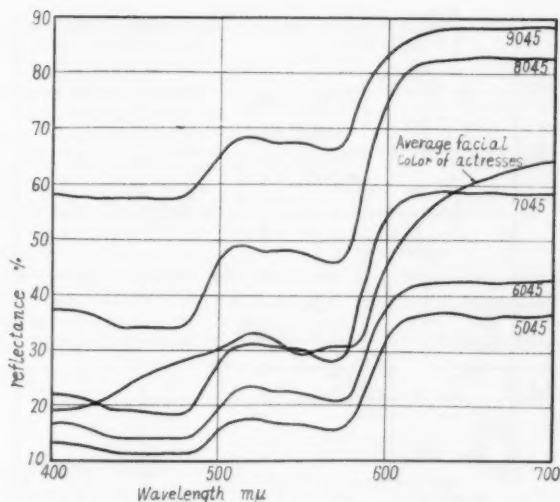


Fig. 10. Example of spectrophotometric curves of High-con.

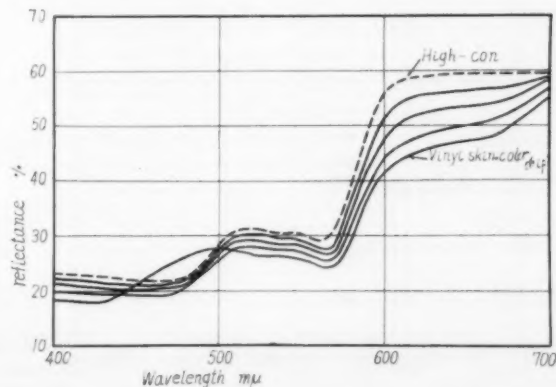


Fig. 11. Change of spectrophotometric characteristics of skin color with High-con.

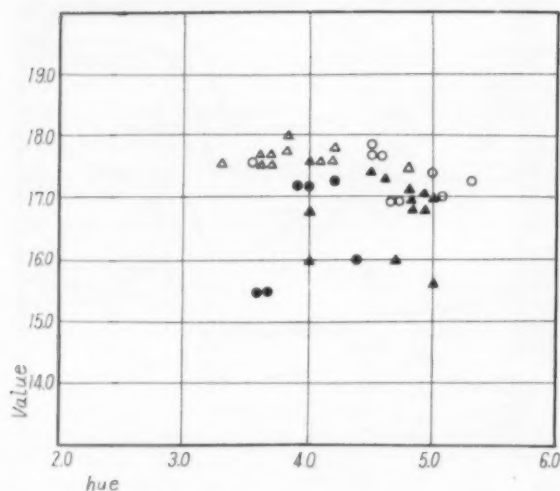


Fig. 12. Example of visual measurement of actors' face color. The case of Toei's *The Sunset and the Revolver*: Δ , female forehead; \circ , female cheek; \blacktriangle , male forehead; \bullet , male cheek.

in the motion-picture studios and observed from practical investigations of the coloring of make-up materials, good cosmetics, from the viewpoint of the skin-color distribution and of the liberty of creation in dramatic characters, are limited to quite a small field.

On Skin-Color Distribution

The most notable skin-color inquiries in the Japan Color Research Institute are as follows:

1955 — The measurement of 78 persons (including male and female actors, student apprentices of Daiei and other employees)² making use of the Color Scale of Our Standard Colors.

1955 — The measurement of the facial colors of actors in *The Renovated Tales of Heike* (Daiei). We used the vinyl solid skin-color chips.

1956 — The measurement of 50 actors in *The Sunset and the Revolver* (Toei), using the vinyl skin-color chips and the recording spectrophotometer.⁴

1957 — The measurement with vinyl skin-color chips of 60 business girls in K Co.⁶

1958 — The detailed measurement of the facial colors of personnel of the Japan Color Research Institute.⁷

In addition, a great deal of material concerning the measurement of skin colors of actors, etc., is available at the Japan Color Research Institute.

For instance, Fig. 12 shows the results of visual estimation in the case of Toei's *The Sunset and the Revolver*.

We have attempted to establish a standard of color range which, as is seen in Table I, could be classified in nine skin-color types, based on the location of any skin color within the distribution of all of the data.

Nevertheless, since this standard of color range consists principally of the ordinary facial colors of Japanese movie actors and business men, it is necessary that we include the examination of the skin colors of the farmer, the fisherman,

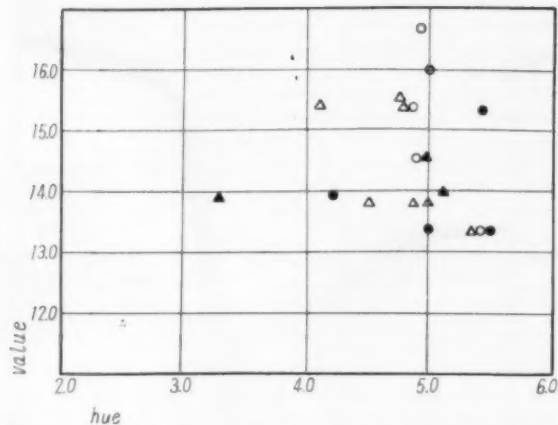


Fig. 13. Example of visual measurement of the farmers' and the fishermen's facial colors. The case of Toei's *The Rice*: Δ , female forehead; \circ , female cheek; \blacktriangle , male forehead; \bullet , male cheek.

the laborer, the patient, the child and the aged. Moreover, for movie characters, we must estimate the color of the face of fantastic persons, for example, a phantom.

As for the investigation of particular skin colors, we offer for purposes of reference the estimation material on the farmers and the fishermen in Toei's *The Rice* (Fig. 13).

Color Range of Previous Make-up Materials

The color range of representative make-up materials compared with that of skin colors is shown in Fig. 14.

In this example, relatively speaking, the gradation of luminosity responds systematically to the necessary ranges, but in regard to hue scale it does not exceed the narrow range of 3.0 and 4.0. Despite the opinion that the cosmetics of such a hue range are chosen with regard to characteristics of color film's sensibility, we have discovered no scientific foundation for them. Besides, this hue

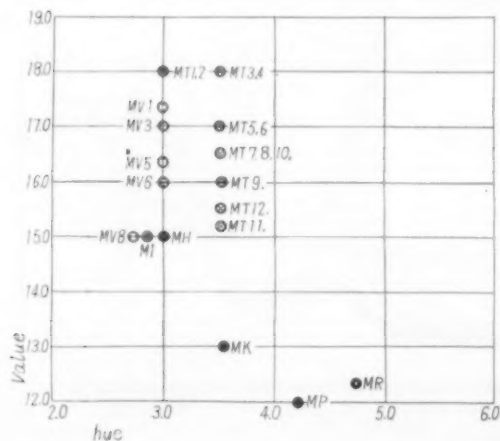


Fig. 14. Example of the color range of previous make-up materials.

Table I. Classification of Skin-Color Types. (Value Notation Determined by the Guide to Standard Colors.)

Hue			
Value	4.0	5.0	
	L R	L N	L Y
	Light Red	Light Natural	Light Yellow
17.25			16.5
	M R	M N	M Y
	Medium Red	Medium Natural	Medium Yellow
16.75			16.0
	D R	D N	D Y
	Dark Red	Dark Natural	Dark Yellow

range has nothing to do with Japanese skin colors. One can say that it is nearly impossible to undertake the make-up of diverse kinds of characters using the cosmetics which have such a narrow color range. Of course, there are also the various make-up materials for the peculiar characters, but we think that there is no rational foundation for them. Most make-up men are satisfied with doing it by their own perceptions.

Discrimination Diagram of Skin-Color Types

A new method which has as its object the rationalization of the make-up process has been developed in the Japan Color Research Institute. It is called "the discrimination diagram of the skin-color types," and is now applied in every motion-picture studio. First we made the skin-color coordinates based on the standard classification table of the skin-color types. One can plot on it the chromaticity of the actors' bare faces or their powdered ones. We comment on this system of make-up with reference to Figs. 15 and 16.

(1) In advance, before make-up, one estimates the bare face of an actor using the skin-color chips or the recording spectrophotometer, and then plots its average numerical values on a diagram as (a) in Fig. 16.

(2) Then, one estimates a finished facial color desired for the intended character, using color samples such as skin-color chips, and one plots its color value in the same way on the diagram, as (b).

(3) Now, as Fig. 16 shows, there appears a disparity between (a) and (b).

It is advisable to select make-up material which controls (a) by moving it to the point of (b). Since the color of make-up can be considered a mixed color composed of the color of the bare face and that of cosmetics, we find the solution on the extended straight line in the direction from (a) to (b).

It is convenient to have certain make-up materials, whose color values are already known, placed side by side in the necessary color ranges. If the most suitable make-up chosen in this manner proves appropriate to the desired character, and is put to use, it is still advisable to measure it again by using the skin-color chips. Then one can retain this color sample and can examine, if necessary, the finished effect of skin color. Thus, working in this way, one can maintain the unity of actors' make-up throughout a motion picture.

There remain, however, two unanswered questions. The first is that one must consider the characteristics of the film's color sensibility, when one chooses the color of make-up material. As for the color film, more minute inquiries are needed. Some progress has been made in this matter.¹¹

Fig. 15. One of the most ideal make-up systems: (1) Select color which meets image of character. (2) Calculate on the coordinates the difference between facial color of character and that of actor. (3) Choose color of make-up material which was calculated on the skin-color coordinates among many systematically arranged materials. (4) Examine whether or not the finished make-up accords with character's facial color. (5) Examine whether or not the facial color which was reproduced on the film accords with the original image of character. (6) Prepare for the crank in by filing the make-up cards which were judged suitable.

We think that this problem has already been solved to some extent, by the test shooting for make-up effects which is often done in the motion-picture studio.

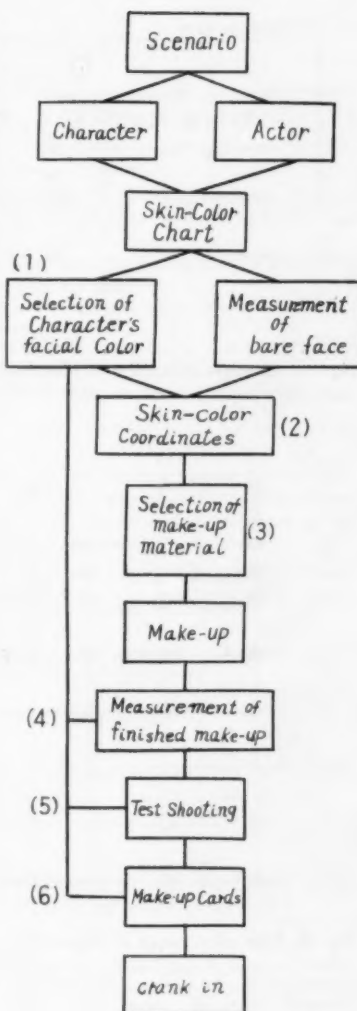
The other problem is: Does the mixed color become in reality the ideal color, as the theory predicts, when one powders the make-up material on the skin?

We shall cite an experiment⁷ which has been reported by the Japan Color Research Institute, an example of which is shown in Figs. 17A and 17B. In the case of thin powdering the ideal colors are relatively attained as indicated by theory, but in the case of thick powdering with, for instance, a yellowish cosmetic more saturated than the actor's real color, it does not necessarily follow that the finished color is more saturated than the actor's skin.

No final judgment can be formed on this problem, but we can say that one must caution against breaking the harmony of the skin color and the cosmetics when one uses make-up materials which are brighter than the bare face.

Color Range of High-con

By taking into account all of the above, we have attempted to establish an organic disposition which designates the



color ranges and the color position of the High-con make-up material.

In Fig. 18 we have taken care to arrange a series of color values on the 3.3 hue line. We followed the precedent set for the previous make-up materials so that the make-up men's experience would

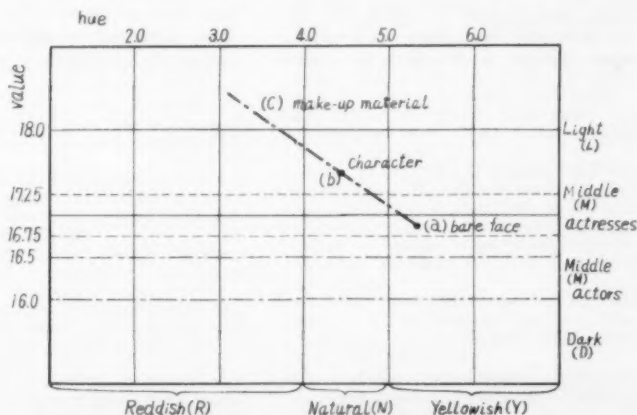


Fig. 16. The skin-color coordinates.

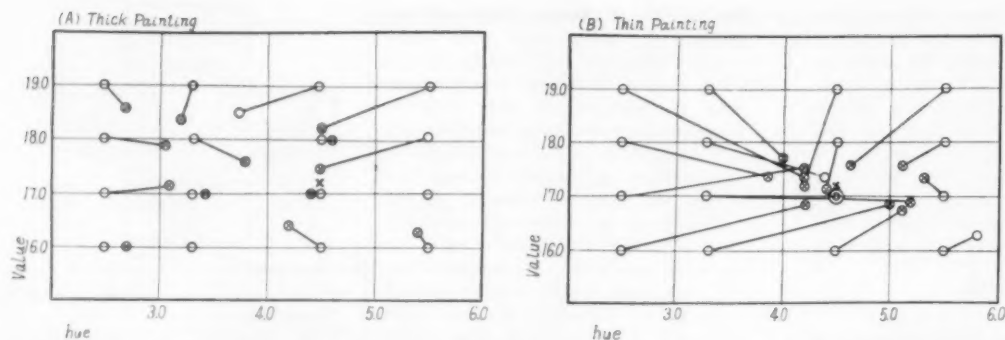


Fig. 17. Changes of facial colors by make-up: (A) thick painting; (B) thin painting; x, type NM skin color; O, make-up material; ⊗, mixed color of skin and make-up material.

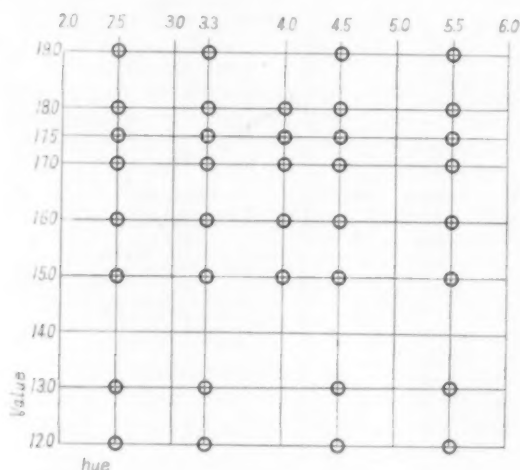


Fig. 18. The color range of High-con.

be of assistance when cosmetics have to be applied on the spot.

As for chromaticity, we have made the High-con Color Sticks a little bit higher in saturation than the average skin color. But we have intentionally arranged, on the line of luminosity, 19 cosmetics having lower saturation, for we thought that some having the effect of traditional white lead should be available. We also provided colors whose luminosity is especially low and which are called

"Yogoshi" (dirty colors) following the same order.

Acknowledgments

We sincerely appreciate the full cooperation of Bunpei Maruoka, President of the Midorigaoka Laboratory of Kanebo Cosmetics Co., Toshiharu Tsunemitsu, Chief Engineer, Manjiro Takagi and the personnel in charge, who made it possible to manufacture High-con on the basis of these investigations.

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Special-Effects Cinematography: A Bibliography

By RAYMOND FIELDING

THE RESOURCES of the special-effects cinematographer have always been highly valued in the Hollywood industry. Generally, such special effects offer visuals which are otherwise impossible to achieve, or which are too difficult, dangerous, time-consuming or expensive to produce by routine methods.

Rarely, however, does the small producer of low-budget television or nontheatrical films seem to realize the extent to which such processes may be used to (a) increase production value, (b) achieve novelty, (c) save set construction materials and labor costs and (d) salvage valuable but technically defective footage.

Today, many competent special-effects firms are in business throughout the country for the benefit of the low-budget producer, offering a variety of image manipulations at a relatively moderate cost. Yet, many small producers remain unfamiliar with either the existence or nature of these effects and so fail to turn to such organizations when their aid is most needed.

To a great extent, then, failure to utilize cinematic effects follows from a lack of familiarity with the technology involved. Unfortunately, pertinent technical literature is widely scattered and covers a period of about fifty years. The following bibliography has been prepared so as to provide a guide to profitable reading and study in this specialized field. It covers an even half-century from 1909 to 1959 and cites 260 periodical articles (of which five are duplicated in a second category), nine books, 23 book articles, and four unpublished research papers.

The bibliography is a selective one from which nine types of articles were explicitly excluded: set construction techniques other than for miniatures and models; time-lapse cinematography; live television effects; amateur cinematography unless quite advanced; cinephotomicrography; animated

cartoon production; high-speed cinematographic effects; routine production lighting effects; and foreign-language periodical literature.

The 260 selections were taken from a total of 18 journals of which five provided 91% of the total:

1. *American Cinematographer* 106 (40%)
2. *International Photographer* 56 (21%)
3. *Journal of the Society of Motion Picture and Television Engineers* 51 (20%)
4. *Cine Technician* 15 (6%)
5. *British Kinematography* 10 (4%)

These 260 articles may be divided among twelve categories, the distribution of which suggests corresponding differences in the amount of time, money and effort spent in the research and development of the different specialties:

1. Background projection 63 (24%)
2. Optical printing and traveling mattes . 38 (15%)
3. Miniatures 32 (12%)
4. Special-effects production, general . . 31 (12%)
5. Fundamentals of special-effects cinematography 22 (8%)
6. Composite cinematography, general . 18 (7%)
7. Biography 17 (7%)
8. (Still) Matte shots 10 (4%)
9. "Day-for-Night" cinematography . . 10 (4%)
10. Effects filters 10 (4%)
11. Patents 6 (2%)
12. Glass shots 3 (1%)

Annotation has been limited to only those items whose content could not be easily inferred from the titles.

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An Infrared Self-Matting Process

By ZOLI VIDOR, A.S.C.

A traveling matte process is described in which advantage is taken of the selective sensitivity of film emulsions toward light, plus and minus infrared rays. How these two exposures are taken simultaneously and these components then used to arrive at a composite is explained. The process requires little studio space.

IN MAKING motion pictures it is often necessary to combine picture information from several pieces of film onto one piece of film, which is usually called a composite. Over the years, combining several pieces of film has been done in many ways, with varying degrees of success.

One method of combining one or more foreground actions with a background is by making a matte. A matte is usually a piece of film which has an opaque portion. If the matte is bi-packed when printing the background, an unexposed portion of the film, corresponding in shape and size to the opaque portion, is obtained. Then something of the same shape and size can be printed into that unexposed portion from a piece of film that has been photographed at another time.

When this opaque portion is moving and therefore changes its shape, size and relative position in the frame, it is called a "traveling" matte.

There are several traveling matte processes, the one to be employed being selected for reasons of economy or personal safety for achieving an effect impossible to achieve in a conventional way, or for a combination of these requirements.

In the conventional rear-screen process a background called the plate is projected onto a screen, the foreground action is put in front of the screen, the two elements are photographed, and a composite negative with the two elements combined is recorded.

Obviously the portion of the background which is eclipsed by the foreground is not photographed. It stands to reason, therefore, that if this portion of

the background could somehow be left unexposed when making the plate, the foreground could then be exposed into that hole. This is exactly the principle of all traveling matte processes.

Infrared Traveling Matte Process

The infrared traveling matte process was invented and patented by Leonard Pickley and developed to its present efficiency by MPO Videotronics, Inc., through many months of experimentation and research.

The beamsplitter camera used by MPO is the 3-Strip Technicolor camera, developed for the Technicolor process. It uses three strips of film; two in one gate and one in the other. We have modified this camera to the extent that we use only two strips of film and have changed the beamsplitter prism to suit our purpose. We thread the gate behind the prism with a film stock sensitive to visual light, such as all panchromatic films or color films;

and from now on we shall call these films "visual films." We then thread the so-called bi-pack side of the camera with infrared film, which is sensitive to the infrared portion of the spectrum from about 700 to 900 mμ. The infrared part of the spectrum covers a much larger range, but we are concerned only with that portion to which our infrared film stock is sensitive.

The problem was to expose the background and nothing but the background on the infrared film. At the same time we wanted to expose the foreground action and nothing but the foreground action on the visual film. Obviously, if we could achieve that, then we could simply make a print of the infrared negative which we call a matte — bi-pack this matte when we print the plate, and print the foreground action into the resulting hole. This is exactly what the various traveling matte processes are doing in one manner or another.

Preparation of Background

In order to achieve our purpose we had to be able to "light" the background with infrared rays. (This is a paradox because infrared rays are invisible to the

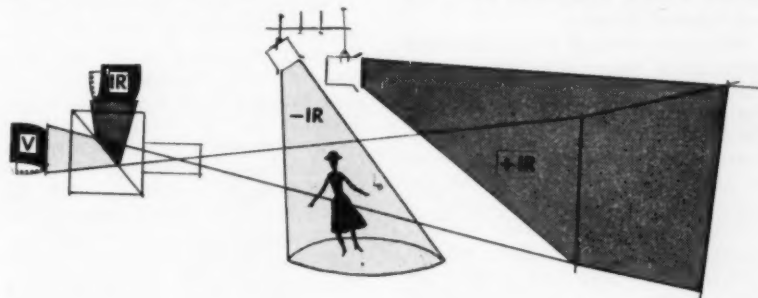
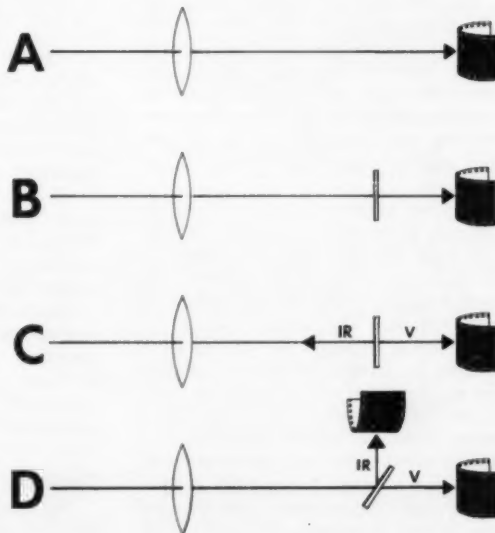


Figure 2



Presented on May 7, 1959, at the Society's Convention in Miami Beach by Zoli Vidor, A.S.C., MPO Videotronics, Inc., 210 West 65 St., New York 23.

(This paper was received on March 31, 1960.)

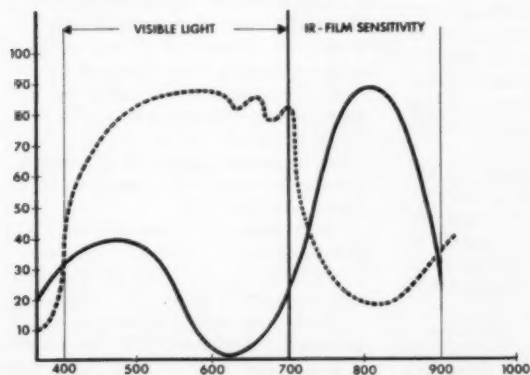


Figure 1

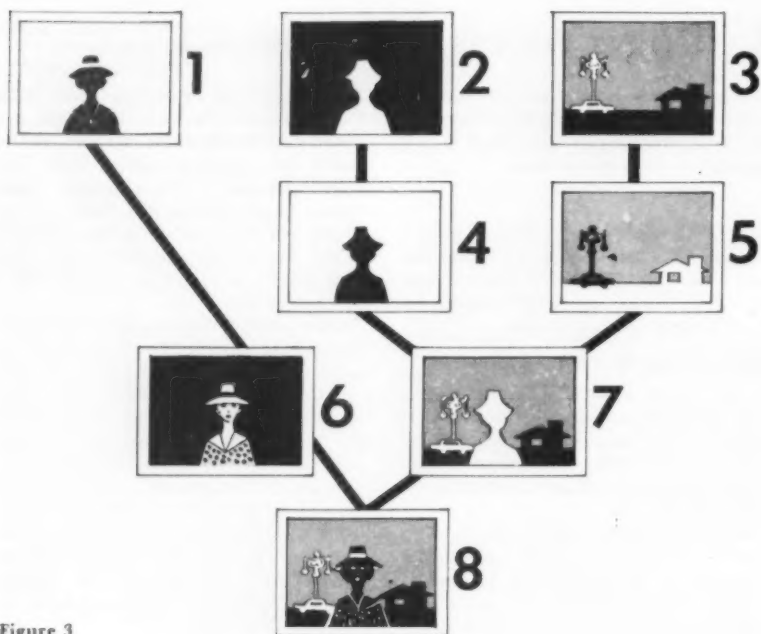


Figure 3

eye and therefore it is incorrect to call them "light" in our terminology.) At the same time this background had to appear black to the visual film. Therefore we had to find a black background which was only infrared reflective.

After some research we found a black velour which, when treated with a certain black dye (name and formula unknown, but the material is available through theatrical drapery supplies), is quite infrared reflective. Further, we found that by backing up this velour with sheet aluminum foil we more than doubled its reflection of infrared rays. This, of course, is quite logical since infrared rays are heat waves and bounce back from aluminum foil or any other polished metal.

The best infrared "light" source for our spectrum range, we have found through trial and error, is the conventional incandescent light. There are many other sources of infrared waves, but unfortunately most of them are above 900 μ , and hence beyond the infrared film sensitivity and impractical for our purposes.

The two curves in Fig. 1 may explain the core of the process in a graphic way. The solid line represents the sensitivity of the infrared film, which is seen to be most sensitive in the areas between 700 and 900 μ . The broken line is the transmission curve of the dichroic filter coating for foreground lighting, and as we see, it cuts off very sharply just within the 700 μ region where it is needed most, while the visible transmission is hardly affected.

Thus the black background is prepared and "illuminated" with infrared rays in such a manner as to give a good

exposure on the infrared film stock but negligible exposure on the visual film stock.

Foreground Lighting

Concerning the visual side of the process, it is necessary to expose the panchromatic film stock but at the same time to avoid exposing the infrared stock with any of the foreground action. Therefore the infrared portion of the spectrum must be prevented from hitting the foreground action because if it should, we would get an exposure of the foreground action on the infrared stock.

It is possible today, with the improvement of techniques in the field of dichroic coatings, to prepare a coating which to a high degree will cut out any desired part of the spectrum. In our case we were trying to prevent a particular portion of the spectrum from lighting the foreground to which the infrared film stock is sensitive, namely 700 to 900 μ .

Special dichroic coatings were devised for our studio light Fresnel lenses so that the infrared waves between 700 and 900 μ are not allowed to pass through, while the remainder of the spectrum is practically undisturbed. Neither the eye nor the panchromatic film stock is affected because what we have eliminated was invisible anyway.

Thus we do not have infrared rays hitting the foreground, but we do have infrared rays hitting the background. To be more specific, the foreground is lit with light minus infrared rays and the background is lit with light plus infrared rays.

Combining of Elements

The next step is to record these two elements on two pieces of film. In order

to have an exactly identical picture, it is essential that these two elements should be exposed through one lens. Figure 2 shows how the light passes through the lens onto the film.

(A) Light passes through the lens onto the film.

(B) If we insert a piece of glass between lens and film, the light still passes through just as before.

(C) If we coat this piece of glass with the same kind of coating as used on the studio light Fresnel lenses, then the visible light will go through this piece of glass as before, but the infrared waves will be bounced back.

(D) If we tilt this glass 45°, then these infrared waves will be bounced back at a 90° angle, and if we place the infrared film in its path we can then receive that exposure; and that is exactly what a split beam camera does.

Of course instead of a piece of glass we use a prism because it is so much more effective. This is the principle in its pure form. We have one drive transporting both strips simultaneously and we photograph through one lens.

The Studio Process

Figure 3 indicates how the process is applied on the studio floor. We see that the background is illuminated with light *plus* infrared rays and the foreground, on the other hand, is illuminated with light *minus* infrared rays. Obviously the minus-infrared light can hit the background without doing any damage, but the plus-infrared light must not hit the foreground action.

In the beamsplitter camera, the light *plus* infrared rays and the light *minus* infrared rays both pass through the same lens but are split by the prism in such a way that the infrared information is received by the infrared film and the visual information by the visual film.

The eight parts of Fig. 3 show how these two records are combined.

(1) On the visual side a conventional modulated negative with a clear background is received because the background is black as far as the visual sensitivity is concerned.

(2) An opaque background with a clear silhouette is received on the infrared side because this film is sensitive only to the infrared background.

(3) This represents the negative of a background, although a fine-grain print would do as well.

(4) A positive matte is obtained by making a high-contrast print of the infrared negative matte.

(5) A fine-grain print of the background is made.

(6) A fine-grain print of the visual negative gives us an opaque background.

(7) A print of (5) on a negative stock is made by bi-packing (4); if developed, it would give us something like a hole in the negative. But we do not develop

this piece of film until we print (6) onto it in register.

(8) We then develop it and obtain a composite negative.

Advantages of Process

We can readily see that this process is fast and economical. It does not require a large studio space; in fact, we have shot this process quite frequently in a space not larger than 20 by 30 ft.

It is not imperative to have the plate shot before the foreground is photographed.

It is quite simple to change the background while there is no cut in the foreground.

The optical work of compositing is straightforward and routine. In fact, frequently we are able to combine the two elements on a pilot pin registration step printer.

This matte process allows us to keep the foreground and background in absolute focus if so required.

At least mention should be made of the problem of timing foreground action to background action, which sometimes is

necessary and is very simple with this process. We could readily synchronize a 16mm projector with the camera (just as it is necessary to synchronize the rear-screen projector with the taking camera, if the rear-screen projection process is used) and make a simple 16mm print of the plate. The actors, instead of watching the screen behind them, could watch a small screen in any strategic position.

We have made double and triple mattes with great success and are finding new and simplified ways of using the process every day.

Video-Tape Signal Analysis

A joint Broadcaster/Bell System report sponsored by the Video Transmission Engineering Advisory Committee

Definitions of terms for impairments relating to signals from both monochrome and color video-tape machines, together with some background material, are presented. It is hoped that more efficient exchange of information in handling network operational problems by broadcasting and telephone personnel will result.

Editorial Note: In order to show clearly the nature of the video-tape signals under discussion in this paper, the illustrations used exaggerate, in many instances, the conditions met in actual operation; in other words, degradations in video-tape recording signals are seldom as extreme as shown.

Introduction

The increasing use of video-tape recording by the network broadcasters has made it important that both Broadcasting and Telephone Company operating people be able to recognize and compare certain signal impairments which are peculiar to the video-tape recording-playback process. This report supplements the booklet "Television Signal Analysis" originally published by the American Telephone and Telegraph Company in 1955. It presents a glossary of terms and brief descriptive information covering impairments which can occur in signals from both monochrome and color video-tape machines. Certain background information is included for completeness.

This report does not purport to set up standard terms for industry use. However, it is hoped that the terms defined will enable more efficient exchange of information in handling network operational problems.

The text of this report has also been separately published as NTC Engineering Report No. 2. Submitted for the Network Transmission Committee as a contribution to the *Journal* on May 16, 1960, by L. B. Davis, American Telephone and Telegraph Co., 195 Broadway, New York 7. The color printing is by courtesy of American Telephone and Telegraph Co. and National Broadcasting Co.

The Video-Tape System

All three major television networks are using Video-Tape Recording (VTR) equipment. Figures 1 and 2 show the appearance of typical VTR equipment.

What appear to be transmission impairments of signals from this equipment may be caused by (a) the tape, (b) the tape machine or (c) the interconnecting facilities.

The Tape Signal-to-Noise Ratio

The chief factors determining the signal-to-noise ratio in the tape are the smoothness of the tape surface and the ability to magnetize the tape to optimum flux density. In the final analysis, it is necessary to choose the best compromise between signal-to-noise ratio and available modulation bandwidth.

The Tape Machine

The most serious impairments caused by the tape mechanism are "head-hunting," "mistracking" and "banding."

Head-Hunting. Because the magnetic head assembly in current VTR equipment is a rotating device controlled by a servo system, it is subject to hunting.

Mistracking. The tape is moved longitudinally past the head by a servo-controlled transport mechanism. Vari-

Representing the Network Broadcasters

H. C. GRONBERG, National Broadcasting Co.

J. SERAFIN, American Broadcasting Co.

W. B. WHALLEY, Columbia Broadcasting System

Representing the Bell System

J. THORPE, A. T. & T. Co., Long Lines

A. G. COFFIN, A. T. & T. Co., Long Lines

L. B. DAVIS, A. T. & T. Co.

F. L. FREIBERGER, Pacific T. & T. Co.

R. W. GAST, N. Y. Tel. Co.

Consultants

C. A. YOUNGER, American Broadcasting Co.

L. WEILAND, National Broadcasting Co.

ations in playback speed with respect to recording speed cause mistracking of the head.

Banding. There are four video heads in each rotating head assembly. Each head records sequentially approximately 16 picture lines in each field. Because of interlace the band appears as 32 lines on a monitor. Many impairments, therefore, show as distinct horizontal bands in the reproduced picture.

Interconnecting Facilities

Problems generally associated with interconnecting facilities are discussed in the prior booklet "Television Signal Analysis." In this connection, a word of caution: Beware that legitimate network transmission troubles are not neglected or overlooked just because they may be similar to, and therefore, assumed to be video-tape impairments. On the other hand, when a tape machine is running at high speed (as during rewind) or is stopped, the output signals may resemble a "microwave open circuit."

Glossary of Impairments

These are listed and illustrated on the following pages.



Fig. 1. Monochrome video-tape recording equipment.

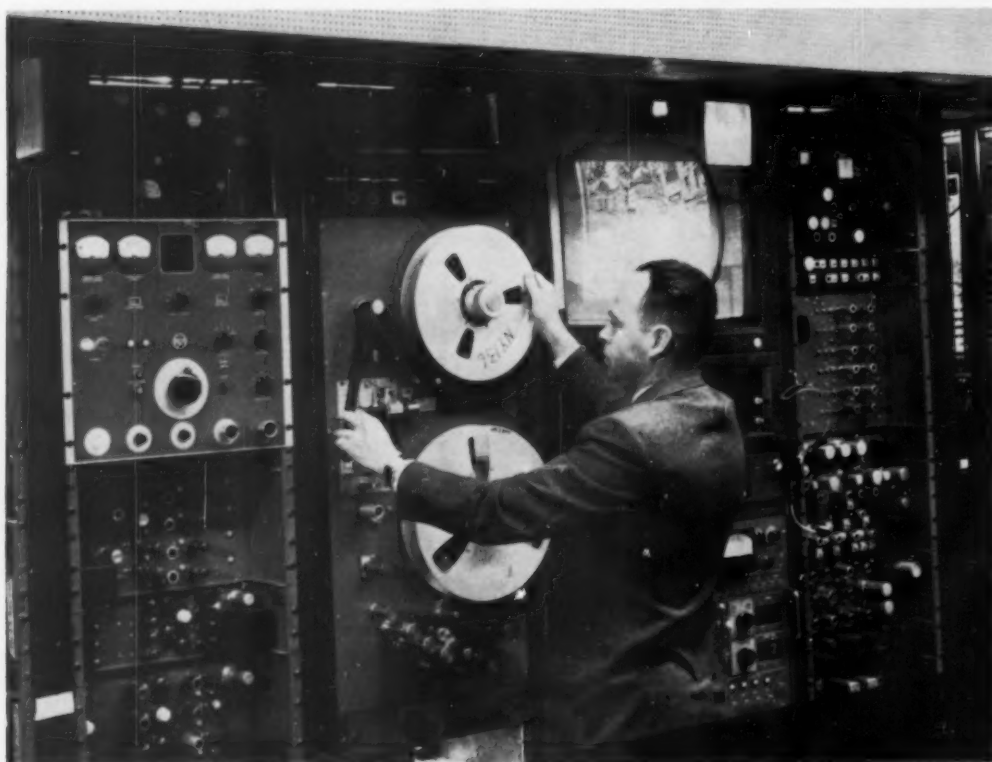
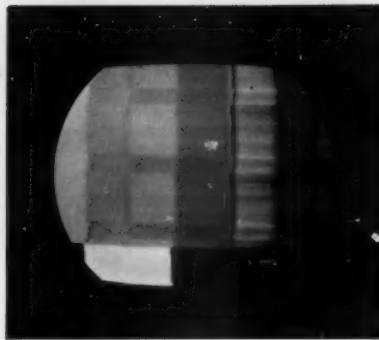
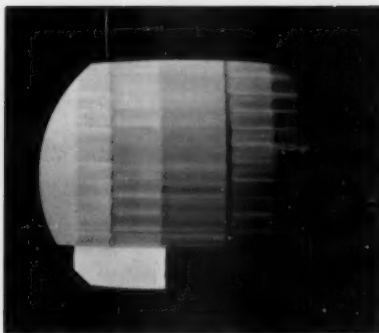


Fig. 2. Color video-tape recording equipment.

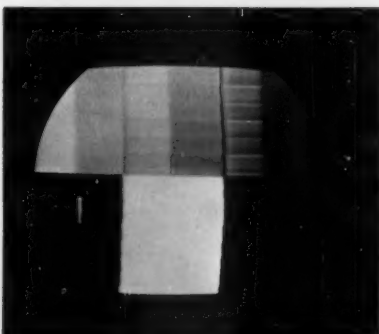
COLOR BANDING



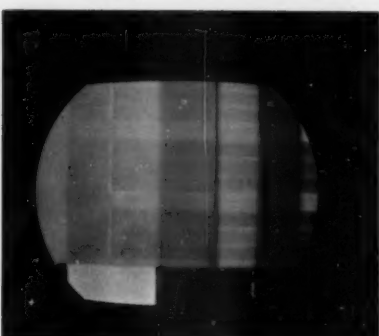
Color Phase Shift Banding. Banding made visible by differences in color phase between head channels.



Hue Shift Banding. Banding made visible by hue shifts within a band.



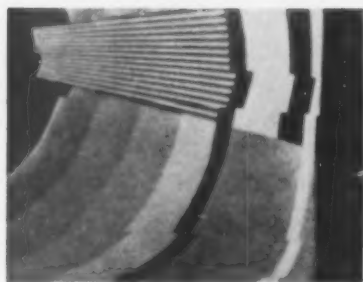
First Line Hue Shift. Banding made visible by a difference in hue of the first line of each band.



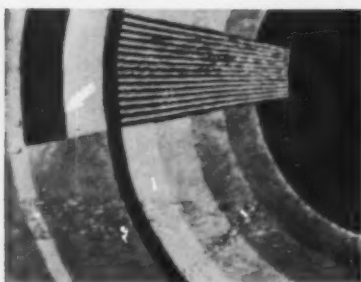
Saturation Banding. Banding made visible by differences in saturation between head channels.

The color printing is by courtesy of American Telephone and Telegraph Co. and National Broadcasting Co.

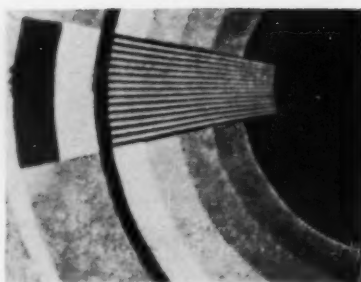
BANDING



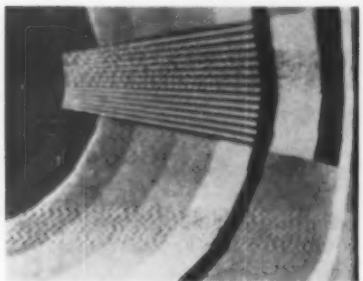
Delay Banding. Banding made visible by differences in head geometry (quadrature), and/or by differences in electrical delay between the head channels.



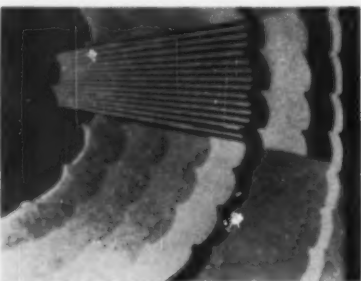
Head Displacement. A recurring displacement of every 16 lines in each reproduced field, caused by a slight horizontal displacement of a head or misadjustment of the switching system.



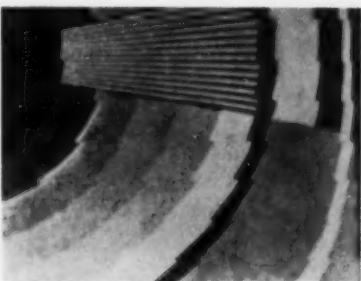
Noise Banding. Banding made visible by differences in signal-to-noise ratios between head channels.



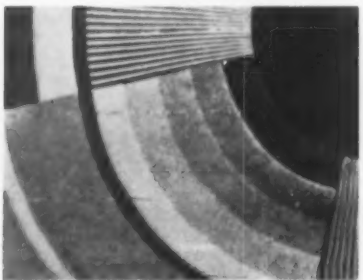
Radiofrequency Banding. Banding made visible by undesirable radiofrequency patterns.



Scalloping. A rounding of the edge of each band of lines caused by incorrect vertical positioning of the tape.



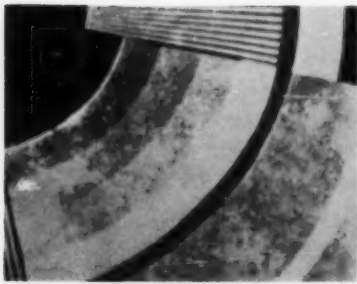
Venetian Blind (not to be confused with co-channel interference). A linear displacement of lines within each band, giving a sawtooth vertical picture edge. It is caused by incorrect pressure between head and tape.



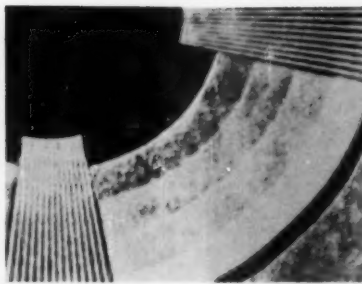
BRUSH NOISE. Repetitive noise which is similar in appearance to ignition noise, caused by faulty slip-ring contact.

CHROMA FLUTTER

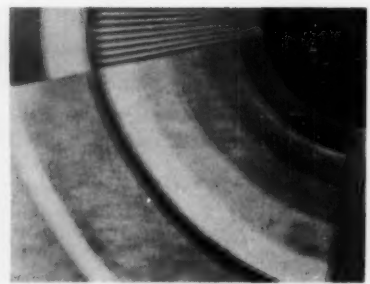
A random change in color saturation in portions of the picture.



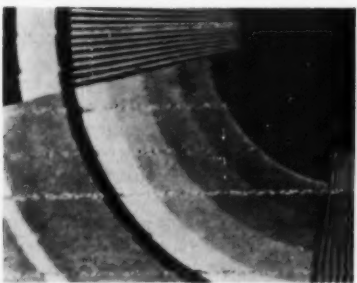
DROPOUTS. Random noise flashes directly associated with imperfections in the magnetic coating of the tape.



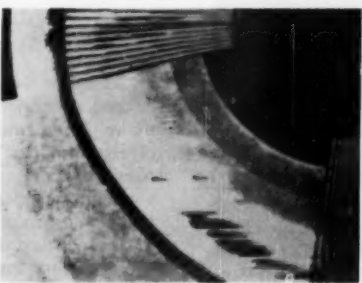
EDGE BEAT. An irregular beat at edges of sharp luminance transitions. This is caused by intermodulation between the various component signals.



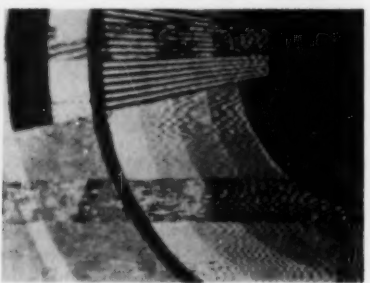
HEAD-HUNTING. A horizontal shifting back and forth of the reproduced picture, caused by undesirable fluctuations in speed of the head.



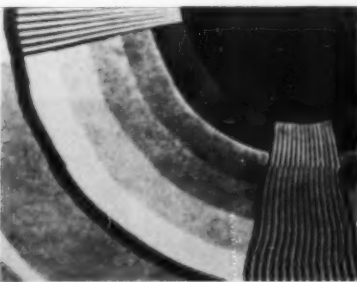
HEAD-SWITCHING TRANSIENTS. White or black transients which occur regularly in bands, resulting from improper operation of the head-switching system.



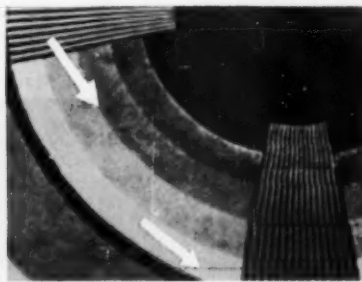
HIGHLIGHT TEARING. Polarity changes of highlight picture areas, caused by overdeviation in the modulation process.



MISTRACKING. Deterioration in picture quality, caused by errors in positioning of the tape with respect to the head. The degree of impairment may vary from a reduced signal-to-noise ratio through heavy moiré to complete loss of picture.



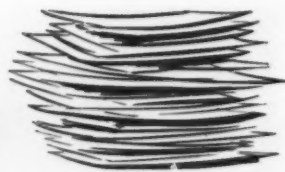
ROTATIONAL "S" DISTORTION. A horizontal shift of picture lines in time with a rotation of the head (repeating every 4 heads).



SCRATCHES. Noise flashes forming a geometrical pattern, usually diagonal, and caused by physical scratches in the magnetic material.

WATERFALL

A shimmering effect over the entire picture, which may be caused by defective or worn bearings.



87th Convention Exhibit being officially opened by Hollywood Starlet Karen Stefance, with President Norwood L. Simmons, Local Arrangements Chairman Robert G. Hufford, Convention Vice-President Reid H. Ray and Exhibit Chairman Harry Teitelbaum.

87th Convention—Los Angeles

Improved pictures of high quality on TV screens, sturdier equipment and more precise and accurate techniques for recording and improving visual and aural images of the entertainment, industrial and scientific worlds were highlights of the 80 technical papers read at the 87th Semiannual Convention of the Society of Motion Picture and Television Engineers.

More than 1100 members registered for the week-long session held at the Ambassador Hotel May 1 to 6, while still another 1000 visited the exhibit of TV and motion-picture equipment which filled 5000 sq ft of space in one of the Ambassador's exhibit areas. Concentration, for the first time at the Ambassador, of the registration, session and exhibit facilities in one area of the hotel made for a more than usually successful convention, as far as arrangements were concerned, and the large crowds were handled without confusion. A new system of registration forms and good organization by the Registration Committee made it possible for the processing of registrants with even less than the usual delays.

The SMPTE Coffee Club, operating thanks to the generosity of Hollywood Film Co., and located in the beautiful Lido Patio among the tropical flowers of the hotel garden, was a pleasant retreat for the foot-weary.

The Space Age dominated many of the technical papers and also the exhibit areas with models of Tiros, the weather satellite built by RCA, and of Pioneer V and Discoverer VI built by Space Technology Laboratories.

At the same time, the talks prepared by both industrial and educational scientists called for an expansion of the program for training in the motion-picture and television fields at the college level.

Get-Together Luncheon

The convention began on Monday with the traditional "get-together" lunch at which President Norwood Simmons presided. In his opening talk Dr. Simmons said:

"In May 1950, just exactly a decade ago, the Society of Motion Picture Engineers was faced with a critical decision. Ever since 1917, when it was founded, the Society's interests had been properly confined to the 'movies' — first silent, then sound. Now television had come of age. The Governors of SMPE were, fortunately, endowed with the wisdom and foresight necessary to recognize that this product of electronic wizardry would assume great importance in the entertainment field — and as a general means of audio-visual communication in the daily lives of all of us. Thus, the name was changed — SMPE became SMPTE. We began Act II of our development.

"Now, in 1960, we again stand upon a threshold of expansion and change.

"Manifold uses of motion pictures and television have been devised by engineers, by businessmen, by creative thinkers in many places, until now we find our Society burgeoning with diverse projects. Yet, throughout all these fields of interest — missile and space technology, business and industry, education, medicine, religion, entertainment, or what have you — we find a common thread. That is the attempt to do a better job of imaging or recording an event. The recognition that SMPTE is no longer 'motion picture' oriented, or 'television' oriented — but is 'visual communications' oriented, has come to many of us. And so the curtain rises — Act III.

"The 87th Convention program reflects well this new attitude, which cuts across fields of use and encourages development of methods which will be helpful in many places in today's enlarging world of communications.

"One of the duties of a progressive engineering society is to try to impress upon management the vital need for research and development, since they are necessary parts of good engineering. Research requires the expenditure of a little today, and produces a lot tomorrow. Our Society has a heavy responsibility in this regard; some of our managements refuse to concede



President Norwood L. Simmons, Stanley Kramer and Art Linkletter chat before Get-Together Luncheon, at which the latter two were featured speakers.



Krafft Ehrlicke of Convair Division, General Dynamics Corp., and President Norwood L. Simmons in the Press Room after Ehrlicke's talk on Tuesday evening.

that scientific research is not susceptible to cost accounting before the fact. I believe that this Convention, by bringing the bright light of public attention to focus upon its engineering achievements, will elicit more interest and support by management in the affairs of our Society."

During the introductory portion of the luncheon Art Linkletter entertained the guests with a barrage of his rapid-fire wit that was greatly enjoyed.

The keynote speaker for the occasion, introduced by the President as a "man of integrity . . . who has established himself firmly as a creative motion-picture producer of courage . . . and . . . is to be admired because he is able to exert great influence of the right kind on people's minds," was independent producer Stanley Kramer. In his frank and stimulating talk, Mr. Kramer asserted the importance of motion pictures as a medium for conveying ideas which should concern our society, without regard for their acceptability. "Today," said Mr. Kramer, "in trying to reach the public the movie producer is entering a field replete with the pitfalls of controversy."

Reid H. Ray, Convention Vice-President, summed up the 87th Convention in this manner:

"The success of the 87th Convention, with the largest registered attendance in seven years, proves that a well-balanced



Banquet Chairman Walter L. Farley, Convention Vice-President Reid H. Ray, Local Arrangements Chairman Robert G. Hufford and Local Arrangements Vice-Chairman Ralph E. Lovell at work in the Lido Patio.

papers program on realistic subjects attracts engineers in the areas of motion pictures, television and allied fields. The emphasis at the technical sessions in Los Angeles was slanted on techniques that would produce improved quality in television broadcasting, acoustics and sound, films in industry, instrumentation, laboratory practices and television recording. The exhibits drew many visitors from the Los Angeles area to the booths in the Sunset Room, adjoining the Ambassador Ballroom where the technical sessions were held. This convenience was a distinct advantage both to exhibitors and those attending the convention."

Papers Program

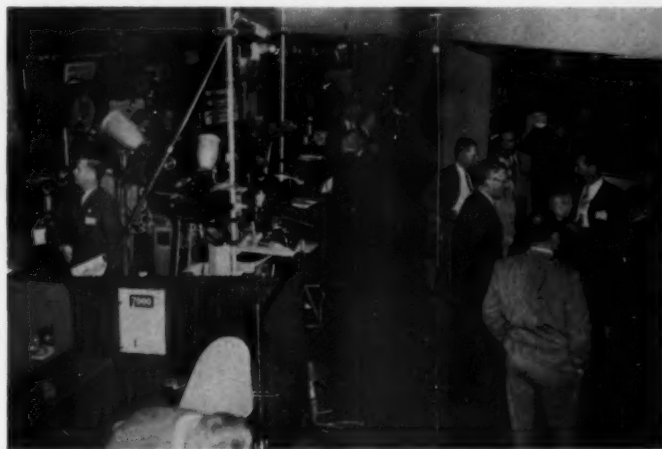
Elimination of distortion from taped programs; the better blending of tape, live and film shows; and more detailed recording of images on both tape and film are but a few of the improvements reported by the scientists.

Equally important, the engineers observed, was the development of new TV cameras which insure uniform picture brightness, greater reliability, and more mobility. The result, they say, is the freeing of the television cameraman from technical worries to allow him time and the means for the exercise of artistic imagination and creativity.

Affecting both the TV and motion-picture fields was a new thermoplastic recording process at present in the development



President Norwood L. Simmons and Past-President Barton Kreuzer are interviewed by press and Los Angeles TV station.



A section of the Exhibit in the Ambassador Sunset Room.



Garland C. Misener, Mrs. Reid H. Ray, Norwood L. Simmons, Janet Blair (Mrs. Nick Mayo), Reid H. Ray, Mrs. Barton Kreuzer, Nick Mayo and Barton Kreuzer at the banquet.

state, which was said to be capable of recording and storing either color or black-and-white images on a reel of film.

One of the highlights of the convention was the stressing in the Space Age sessions of the important part motion pictures and television will play in reporting back findings of space probing instruments — developments which in the next few years are expected to find their way into the amateur and professional photographic and recording fields.

A startling statement came when Krafft Ehrlicke, developer of the Centaur program for Convair Astronautics and guest speaker at the Space Technology Session, implied that a fusion bomb in a nuclear-powered rocket sometime would soar through space for a year and a half, and somewhere beyond Jupiter, serve as a giant flash bulb to permit televising back to earth the content of the jet blackness surrounding Pluto.

Among important developments reported at the Space Technology Session were:

A fiber optics lens, composed of scores of tiny threads, which permit medical examination of hitherto inaccessible areas of the body, or even photographing or televising areas too dangerous for man to enter; a simple recording device which can be adapted to either 8mm or 16mm sound cameras and projectors for synchronized sound reproduction; a system of photography which indicates photographs from an altitude of 175 miles would reveal the number of parked cars in a driveway; new high-

speed film, both black-and-white and color, that will extend the photographic potential of night and action scenes for TV and motion-picture film, thereby expanding the scope of action and lowering the cost of production; and a new 8mm sound projector for home and industrial use which may make available professional motion pictures at one fourth the previous cost and which will extend the potential for amateur photographers recording and reproducing their own sound.

The early sessions of the convention were devoted to general topics, Acoustics and Sound, Optics and Images, and Films in Industry.

Several research papers included technical reports on improved lenses, new recording techniques, and methods of transmitting space images and sounds.

In the general sessions, Congressional assistance in storing and preserving many of the important documents and entertainment programs which may be destroyed for want of storage space was called for.

Heads of industrial and military film departments stressed the important part film, tape and television are playing in training personnel and analyzing mechanical and scientific production in a manner not otherwise possible.

While engineers in their sessions were reporting technical progress that would lead to improvement in the television arts, the training and teaching sessions of the SMPTE were being critical of the training facilities being offered to students of both the cinema and television. They said the United States is falling behind Russia in training personnel in the important field of motion-picture and television communications.

Where one school in Moscow is training 600 students at the graduate level, Don G. Williams, director of motion-picture production at the University of Kansas City, declared the country's top 10 schools with cinema courses are training only 685 cinema students. He also stated the Iron Curtain countries are training 10 cinema and TV students for every one in this country.

Williams pointed out that the Russian cinema students are selected on the basis of loyalty to the Communist party line, are completely supported by the government, and are given a six-year course in liberal arts, and all phases of technical and artistic production.

John Tyo of System Development Corp. reported that his survey of the 10 top cinema courses showed only 685 cinema majors and charged that many of the courses are parochial in outlook and methods.



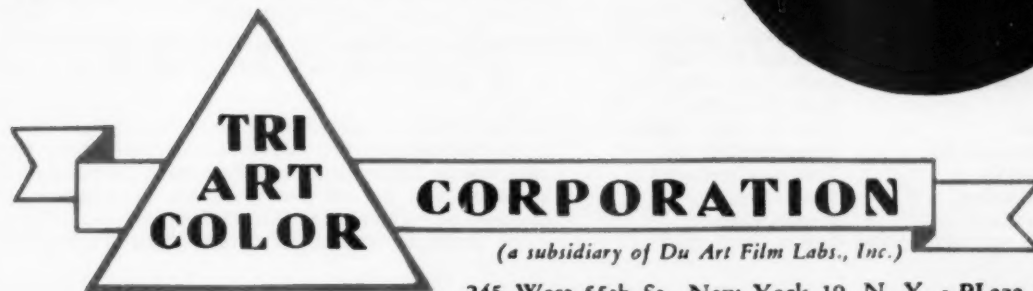
Cocktail party at the Ambassador Pool before the Wednesday evening Banquet.



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Convention Vice-President Reid H. Ray, Auditor Frank Montfort, Public Address and Recording Chairman Ralph Sogge and Projection Committee Chairman Donald Kloeppel at the Cocktail party.

Attendance at the sessions of this 87th Convention was the largest since the 1953 Los Angeles Convention, when wide-screen techniques were first introduced. At the Thursday evening session on television recording, an audience of 700 filled the Ambassador ballroom to capacity.

Sessions of the convention were presided over by the following topic chairmen, whose intensive effort produced such a fine papers program:

Acoustics and Architecture of Studios and Stages: FRANK E. PONTIUS; Films in Industry: JULIAN ELY; Laboratory Practices: EDWARD H. REICHARD; New Photographic Materials: VAUGHN SHANER; Optics and Images: ALAN M. GUNDELFINGER; Sound Recording and Reproduction: EDWARD P. ANCONA, JR.; Space Age Motion Pictures and Television: LLOYD T. GOLDSMITH (Assisted by CARLOS H. ELMER and ROBERT D. SHOBERG); Television Equipment and Practices: THEODORE B. GRENIER; Television Recording: RALPH E. LOVELL; Training Personnel for Television and Motion Pictures: ROBERT W. WAGNER.

Equipment Exhibit

The largest and busiest Exhibit at any SMPTE convention to date, with 43 booths, was a great attraction. Live demonstrations of color video-tape recording drew much attention. Companies exhibiting were:

Amplex Corp.
Arriflex Corp. of America
Bach Auricon, Inc.
Bell & Howell Co.
Birns & Sawyer Cine Equipment Inc.
Camera Equipment Co.
Computer Measurements Inc.
Electronic Systems, Inc.
Florman & Babb, Inc.
Great Books of the Western World
Karl Heitz, Inc.
Hi-Speed Equipment, Inc.
Hollywood Film Co.
Houston Fearless Corp.
Lipsner-Smith Corp.

J. G. McAlister, Inc.
Magnasync Corp.
D. B. Milliken Co.
Minnesota Mining & Mfg. Co.
Mole-Richardson, Inc.
Moviola Mfg. Co.
Neumade Products Corp.
Precision Laboratories Div.
Prestoseal Mfg. Corp.
Radio Corp. of America
Ryder Sound Services, Inc.
S.O.S. Cinema Supply Co.
Telescript-CSP, Inc.
Television Specialty Co.
Traid Corp.
Westrex Corp.

Banquet

Guests at the cocktail party which preceded the usual banquet and dance on Wednesday evening were treated to a Hawaiian entertainment, courtesy of W. J. German, Inc. As in the past, this event took place at the Ambassador Pool, a most agreeable setting.

The banquet which followed in the Cocoanut Grove was also voted a great success, partly because of the good food and music (the latter provided by Gisele MacKenzie and Freddie Martin's orchestra), and also because of the absence of speeches. Almost 600 attended.

Ladies Program

Thanks to co-hostesses Mrs. Robert G. Hufford and Mrs. Norwood L. Simmons and the Ladies Committee, the week was arranged to give the ladies attending the convention all the relaxation they desired (in the moderately good California sunshine) as well as some interesting trips. Highlights of the week were a tour and lunch at the Paramount Studios, at which Edith Head, the noted dress designer, was the speaker; an all-day tour of Disneyland; a visit to Art Linkletter's Houseparty; and a lunch at Farmer's Market.

Committees

The members of the convention committees, to whom thanks are due for a tremendously successful and well-planned convention, were:

PROGRAM — HERBERT E. FARMER

Motion Picture Short Subjects — WILLIAM GEPHART
Papers Committee Chairman — BERNARD D. PLAKUN
Papers Committee Regional Chairmen — CHARLES D. BEELAND, JR.; HAROLD E. EDGERTON; HERBERT E. FARMER; C. L. GRAHAM; RALPH HUCABY; R. A. ISBERG; RODDY K. KEITZ; MAX BEARD; PHILIP E. SMITH; J. PAUL WEISS; RODGER J. ROSS

LOCAL ARRANGEMENTS — ROBERT G. HUFFORD

Vice-Chairman, RALPH E. LOVELL

Exhibits — HARRY TEITELBAUM

Hotel Arrangements — DENNIS F. GODFREY

Registration — ARTHUR JACOBS and ROBERT CREAMER

Publicity — THORNTON SARGENT and JACK M. GOETZ

Banquet — WALTER L. FARLEY, JR.

Luncheon — ALAN M. GUNDELFINGER

Auditors — ARTHUR JOHNSON and FRANK MONTFORT

Hospitality — THEODORE B. GRENIER

Membership — HARRY J. LEHMAN

Projection — DON V. KLOEPFEL

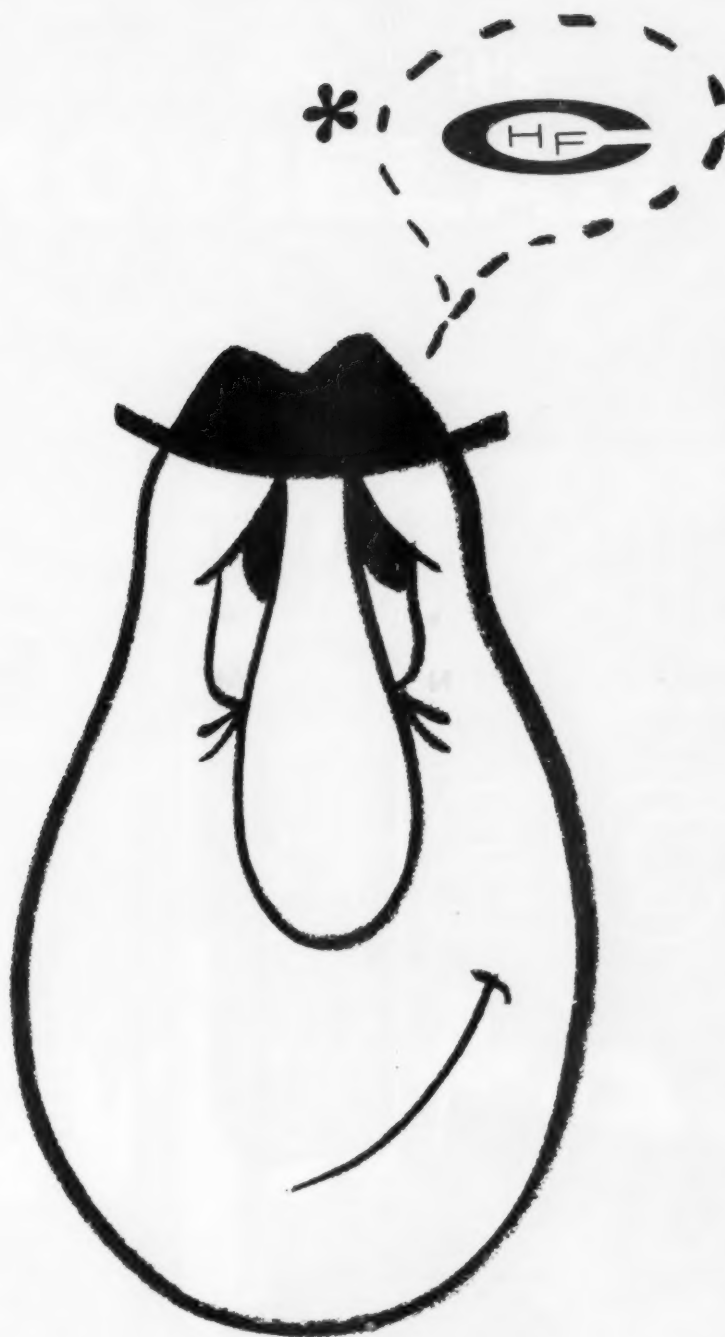
Public Address and Recording — RALPH SOGGE

Ladies Program — MRS. ROBERT G. HUFFORD and MRS. NORWOOD L. SIMMONS

Transportation — RUSS LANDERS

Administrative Assistants — EDWARD P. ANCONA, HOWARD R. BELL, ROBERT W. BISHOP and JOHN G. STOTT

Much credit for a successful convention should also be given to the Ambassador's able Convention Manager, Harry Kerman, and the fine service given by the hotel management on all occasions. This was the Society's fourth convention at the Ambassador.—Thornton Sargent, *Publicity Chairman*.



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Education, Industry News

Giantview Television Network, a closed-circuit television and video-tape program producer of Detroit and New York, has changed its corporate name to General Television Network. The announcement stated that the reason for the change is to give separate identities to the company's closed-circuit operations and its equipment manufacturing division. The Giantview name will be retained on TV and electronic equipment produced by the firm's manufacturing division. The firm was founded in 1958. In connection with its closed-circuit activities it operates mobile and studio Videotape® facilities. It has recently

issued a new rate card for its mobile unit, which is available for use on location anywhere in North America. Two types of services are available. Package No. 1 includes a tape recorder and cue, erase, audio and video channels; tape splicer, timer and reels for 15 to 90 min. The rates, which begin at \$600 per day include the services of a supervisory engineer for an eight-hour day. Package No. 2, in addition to the tape recorder, includes two image-orthicon broadcast cameras and complete equipment. Rates, beginning at \$1450 per day include the services of a full crew. (*TM Ampex Corp.)

The 68th Annual Meeting of the American Society for Engineering Education

will be held at Purdue University, Lafayette, Ind., June 20-24, 1960. A series of conferences on themes related to engineering education will begin Monday, June 20, with a discussion of the National Survey of Technical Institute Education. The survey conducted by the ASEE and the U.S. Office of Education covered technical institutes, defined in the report as "institutions of higher education with programs of less than four years' duration." (*Journal*, p. 542, Aug. 1958). Panel members will discuss major findings of the survey, implications of the survey for engineering education, implications for industry, and implications for guidance and counseling.

Other significant themes to be explored, among others, include Long Range Education and Development of the Engineer; The Role of ASEE in Latin-American Relations and Development of Graduates. An especially interesting conference will be conducted by L. K. Downing of Howard University on Education Programs of Some Professional Engineering Societies. Programs of seven engineering societies and that of the Institute of Aeronautical Sciences will be discussed.

A new television station has been constructed at Recife, Brazil, and is scheduled to begin operating on a regular basis in the near future. Scheduled test transmissions are now underway. The building contains three studios. Studio and transmission equipment have been supplied by Marconi's Wireless Telegraph Co., Ltd., Chelmsford, Essex, England. Studio equipment includes seven 4½-in. image-orthicon cameras, master control equipment, two vidicon telecine units and lighting, sound, test and ancillary equipment. A three-camera outside broadcast vehicle and microwave link equipment are provided. Transmission equipment consists of Band I 18 kw vision and 9 kw sound transmitters feeding into a 6-stack quadrant aerial, providing an effective radiated power of 110 kw. The equipment operates on 625-line standards and is capable of handling a compatible color service. The station is owned by Empresa Jornal do Comercio S.A., Recife.

More than 80 Marconi Mark IV TV camera channels have been installed since the first of the year in broadcasting studios in Great Britain, Canada, the United States, Australia, Denmark, Switzerland, Italy and Poland. A recent order for three camera channels was placed by Elektrim, the official Polish import and export organization for electrical products, to be installed in Warsaw studios. The cameras will operate to O.I.R. standards (625 lines, 50 fields, 8 mc channels).

Thirty-five 16mm films and 17 35mm filmstrips won Blue Ribbon Awards from a field of 300 entries at the American Film Festival held April 20-23, in New York. The films and filmstrips were reviewed in 33 competitive categories under general classifications of Art and Culture; Business and Industry; Education and Information; Health and Medicine, and Religion and Ethics. The Awards Presentation was presided over by Elliott H. Kone,

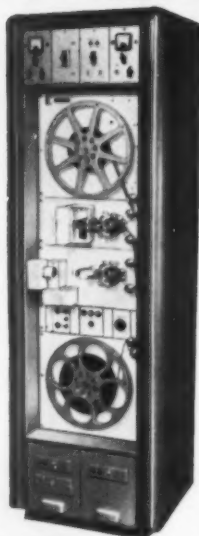
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Director of the Audio Visual Center of Yale University and President of the Educational Film Library Association, which sponsors the annual American Film Festival. Eight of the Blue Ribbon winners—five films and three filmstrips—were produced by the National Film Board of Canada—a record total. A number of foreign films were entered, with Blue Ribbons going to *Richard III*, produced by Sir Laurence Olivier; *Between the Tides* (in the Nature and Wildlife category), produced by British Transport Films; and *The Red Balloon*, produced in France by Albert Lamorisse.

A collection of recordings of the voices of motion-picture pioneers has been pre-

sented to the Film Archive of the Dept. of Theater Arts, Univ. of California, Los Angeles by the noted Hollywood Cinematographer, Charles G. Clarke. The collection includes a recording of the voice of Thomas A. Edison. The Film Archive has also acquired an extremely rare pre-World War II film (circa 1932) of Adolf Hitler addressing German factory workers. This is believed to be the last existing print of this film.

Papers reporting studies conducted by Bell Telephone Laboratories, 463 West St., New York 14, on various aspects of human vision were presented at the Spring Meeting of the American Optical Society in Washington, D.C. A paper by George

Sperling describes experiments in vision in which an observer can see only a negative after-image of an object. In the procedure an intense image is flashed for a very short time and then followed by a plain white field which lasts for 1/15 sec. When the test image occurs about 1/100 sec before the white field, the image will look like its photographic negative.

A paper by Bela Julesz describes peculiar and sometimes unexpected depth effects observed during experiments on binocular vision. Work on this aspect of vision began during an attempt to program a computer to find parallax shifts automatically. A paper by Emanuel Averbach and Abner S. Coriell describes experiments showing that the human eye can "remember" a great deal of information for a short time. Further investigations in this area are expected to shed light on how the nervous system stores and scans information as well as on the manner in which such information is transferred and processed.

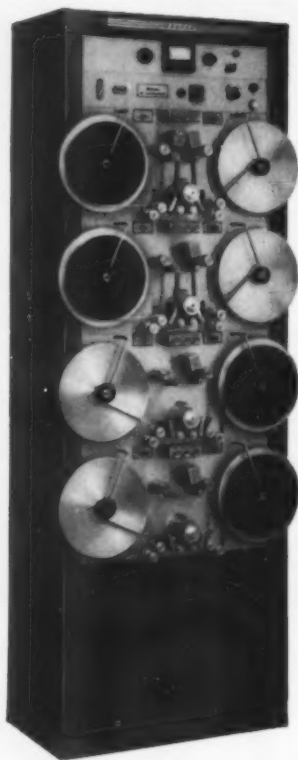
The Cinema Collector, the Journal of the Society of Cinema Collectors and Historians, has published an unusual appeal for help to its membership in a Message from the President. The present officers of the organization, Irving Browning, President; Carl-Frederick Nelson, Vice-President; Lawrence Morales, Secretary, and Saul Haber, Treasurer, are not only willing, but eager — and perhaps anxious — to place the reins of office in other hands. "We have tried for a change of officers," the Message states, "... it begins to look like we don't want to give up. However, this is not so. We are entitled to be relieved by ballot in an election which should take place as soon as possible."

The organization, now in its eighth year, is made up of collectors of moviana and others interested in the history of motion pictures.

Newly elected officers of the Motion Picture Industry Credit Group of the National Association of Credit Management, 44 E. 23 St., New York 10, are: Co-Chairmen, S. C. Robbins, of Movielab Film Laboratories, Inc., and Walter J. Lynch, of Capital Film Laboratories, Inc.; Vice-Chairman, Jack Fellers, of Du Art Film Laboratories, Inc.; Committee-Men, George Elstad, of Precision Film Laboratories, Inc., Daniel Nemeth, of Technical Film Studios, Inc., Robert J. Kingsley, of Recording Studios, Inc., and Howard Funsch, of Consolidated Film Industries. The term of office is one year and began May 1. The Group was chartered April 1, 1953 and now has 30 members, including motion-picture processors, equippers, suppliers and service and financial organizations in the metropolitan New York, Washington, D.C. and Chicago area.

Six organizations have announced meetings to be held in connection with the 20th Annual National Audio-Visual Convention in Chicago, Aug. 6-9, 1960. Dates of meetings are: A-V Workshop for Industrial Training Directors, Aug. 8; Illinois Audio-Visual Assn., Aug. 6; Industrial Audio-Visual Assn. (Midwestern Region), Aug. 8; A-V Conference of Medical & Allied Sciences, Aug. 8; Board of Directors of

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the Dept. of Audio-Visual Instruction, National Educational Assn., Aug. 6-7; National Audio-Visual Assn., Aug. 6-9. Exhibits of more than 130 manufacturers and producers will be displayed. Exhibits include 27 displays of language laboratory equipment, accessories and materials. The 1959 NAVA Convention had 12 language laboratory displays and the 1958 Convention had only two.

The 30th Annual Meeting of the Biological Photographic Association will be held Aug. 23-26 in Salt Lake City, Utah. The agenda is planned to interest persons working in various phases of biological and medical photography, including field photography, motion pictures and photomicrography. New equipments and techniques applicable to biological research will be demonstrated and discussed. Award-win-

ning motion pictures will be shown. Meeting Chairman is Howard E. Tribe, Director of the Division of Medical Illustration, University of Utah.

The 12th International Cinematography Engineering Congress will be held September 29 through October 1 in Turin, Italy. Theme of the Congress will be Contribution of Modern Techniques to Cinematography and Television Problems and Present-Day Possibilities of a Standardization. Chairman of the Congress is Dr. Ing. A. Daniele Derossi. Chairman of the General Committee is Dr. Ing. Giovanni Nasi.

The Sixth Conference on Radio-Interference Reduction and Electronic Compatibility will be held Oct. 4-6 at the Museum of Science and Industry, Chicago.

Jointly sponsored by the three military services, the conference is conducted by Armour Research Foundation in cooperation with the IRE Professional Group on Radio Frequency Interference. Electromagnetic interference problems will be the main topic of discussion. Sessions will cover equipment design techniques, instrumentation and measurement, and practical interference reduction. Conference Chairman is Stabley I. Cohn, Assistant Director of Electronics Research, Armour Research Foundation. Conference Secretary is Robert Brausch, Armour Research Foundation, 10 W. 35 St., Chicago 16.

The 1960 Journal Award of the Society of Photographic Scientists and Engineers has been presented to William West and Vernon Saunders, of Kodak Research Laboratories, co-authors of a paper on the chemistry of photographic sensitizers. The award-winning paper, "Experimental Studies of the Mode of Action of Sensitizing Impurities in Thin Crystals of Silver Bromide," published in the *SPSE Journal*, is a study of the behavior of trace materials in silver bromide and their role in photographic sensitivity.

The Society of Photographic Scientists and Engineers conferred the honorary membership grade of Fellow upon four scientists and named two Senior Members during ceremonies held as part of the National Conference held in October 1959 in Chicago. The Fellows are: Charles E. Ives, of Eastman Kodak Co.; F. W. Hellmut Mueller, of Ansco Division of General Aniline and Film Corp.; Deane R. White, Parlin Research Laboratory, E. I. du Pont de Nemours and Co., and T. Howard James, of Eastman Kodak Co. Senior Members are Frances M. Van Allen, Rochester, N.Y. and Norton Goodwin, Washington, D.C.

Mr. Ives, a research associate with Kodak, was cited for 40 years of studies in motion-picture engineering and for development of radically new types of equipment and methods for rapid processing of photographic films. He has published some 30 technical papers on various aspects of his research.

Dr. Mueller, Director of Research for Ansco since 1944, is internationally known for his improvements in Photographic emulsions. Dr. White, a physicist and photographic scientist, has been associated with du Pont since 1927. His research has covered photographic instruments, developing machines, drying processes, x-ray films, film base, and other photographic fields.

Dr. James has conducted extensive research on the theory of development and latent image formation at Kodak Research Laboratories.

Of the above-named honorees two, Mr. Ives and Dr. White, are also Fellows of the SMPTE and each has been the author of papers published in the *Journal*.

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Arthur Florman opening the Workshop-Seminar, with Warren Portman and Charles Lipow, Workshop Coordinator, at the left.



Warren Portman demonstrating a point at one of the six sessions he conducted during the Workshop.

Animation Workshop

The first Florman & Babb Workshop-Seminar in Animation Film Techniques was held June 12-15 in New York with a capacity registration of 100 artists and technicians representing 70 companies and organizations throughout the United States and Canada.

Industrial firms which sent representatives from their motion-picture departments included General Electric, Bell Telephone, Ford, General Motors, IBM, Shell Oil, Lockheed, Martin, North American Aviation, Boeing, Thiokol, Eastman Kodak, Republic Aviation, Continental Can, and

others. Government agencies represented included Redstone Arsenal, Army Air Defense Command, Public Health Service, Argonne National Laboratories, Walter Reed Hospital, Diamond Ordnance Fuze Laboratories and Federal Aviation Center. Universities and colleges represented were North Carolina State College, Indiana University, Purdue and Yale. The seminar was also attended by representatives of motion-picture and television producers including Jam Handy, NBC, Holland-Wegman, Canadian Broadcasting Corp., Robert Lawrence Productions, Phillips-Gutkin Associates and Bay State Film Productions.

The opening seminar was conducted by Ernest M. Pittaro, TV Film Production Supervisor at Dancer-Fitzgerald. Mr. Pittaro, a recognized authority on animation, discussed basic techniques. Distinguished guest speakers at the seminars included Maurice Levy, President of Eastern Effects, Inc.; Peter Cooper, Vice-President of Robert Lawrence Animation, Inc.; Kenneth F. Drake, Vice-President of Gene Deitch Associates; Vic James of Arriflex Corp., and Herbert Kerkow, President of Herbert Kerkow, Inc.

A stimulating panel discussion on various aspects of the storyboard was conducted by Miss Mary Ellen Bute of

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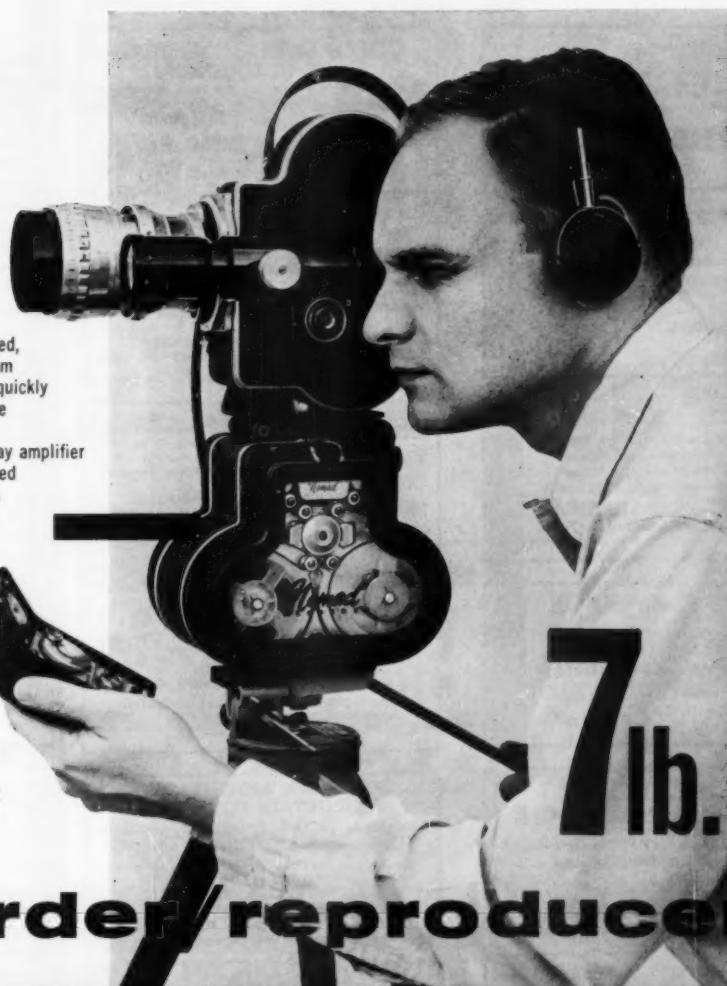
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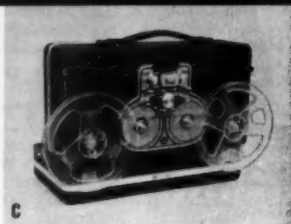
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Ted Nemeth Studios. Panel members included William R. Duffy of McCann-Erickson, Robert Klaeger of Klaeger Film Productions, Robert Yung of Elektra Film Productions and Eli Feldman of Pelican Films. Each panelist introduced a special selection of animation films and answered questions from the floor on problems encountered in originating and developing story concepts. Ted Nemeth Studios prepared an exhibit of original storyboard art material.

Six workshop sessions were led by Warren Portman, designer and manufacturer of animation equipment. Topics discussed included preparation of artwork; basic operation of animation stand and compound; use of the animation camera; and special features of the Triplex stand. Two full sessions were devoted to advanced animation techniques, with a special series of slides showing close-ups of the various operations.

Robert Burns of W. J. German, Inc., Membership Chairman of the New York Region of the SMPTE, discussed the advantages of affiliation with the Society and invited those attending the workshop-seminar to join.

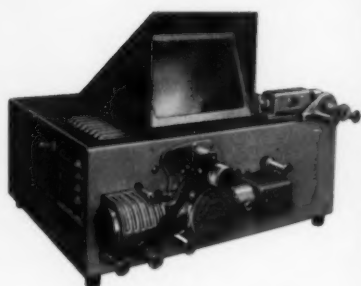
In addition to the workshop and seminar sessions, participants found the time to visit the Ansel Studios where Mr. Portman was able to demonstrate the operation of the Portman Animation Stand under studio conditions. Also on the agenda was a most informative visit to Du Art Laboratories where those attending the seminar were allowed to enter sections of a laboratory usually not open to visitors.

The closing address was delivered by Arthur Florman, President of Florman & Babb, Inc. The idea of a workshop-seminar on animation film techniques was originated by Mr. Florman who, as he noted in his speech, had observed the growing trend toward "in plant" film departments producing their own animation. He mentioned new equipment, such as the Triplex animation stand which has made possible the production of low-budget animation films.

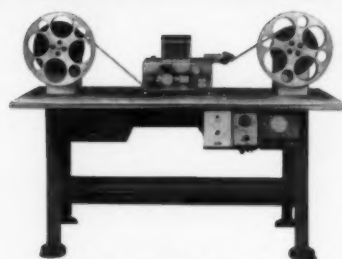
Plans are underway for a second workshop-seminar to be held in the near future.

Capital Film Laboratories, of Washington, D.C., has opened a New York office at 1501 Broadway, New York 36, as part of an expansion program. Head of the new office is Walter Lynch, former Sales Manager for Mecca Film Laboratories. Mr. Lynch is Co-Chairman of the Motion Picture Industry Group of the National Association of Credit Management.

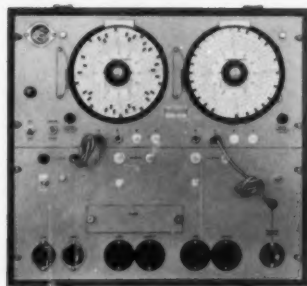
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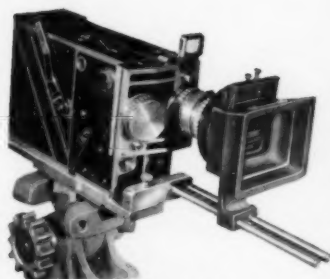
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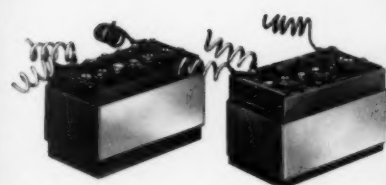
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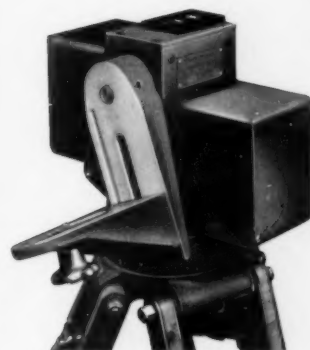
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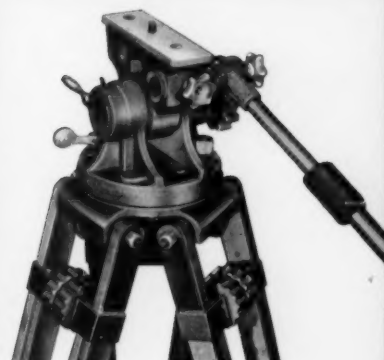
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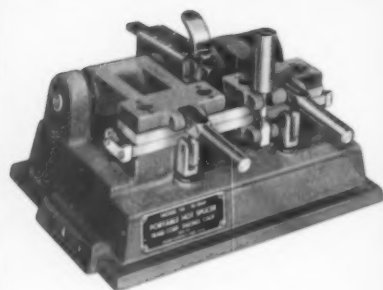
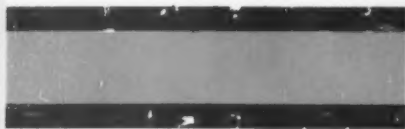
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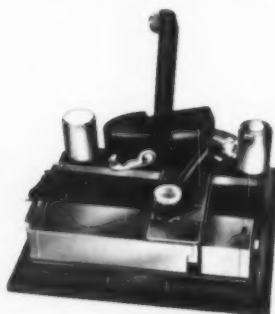


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Colonel Paul Worthman of the Ballistic Missile Div. of the U.S. Air Force will be principal speaker at the banquet session of the 5th Annual Technical Symposium of the Society of Photographic Instrumentation Engineers to be held Aug. 1-4 in Los Angeles. SPIE Technical Symposia are co-sponsored by the Air Force. Areas of interest include terrestrial military and weather reconnaissance, combat surveillance, hydrospace studies, weapons system evaluation, supersonic sled instrumentation, rocket motor testing and other test programs. Col. Worthman is expected to review in his speech related programs in terms of national and international significance.

The 25th anniversary of the founding of the Geo. W. Colburn Laboratory, Inc., 164 N. Wacker Drive, Chicago 6, was marked by an open house celebration held in the firm's executive offices. Festivities included a tour of the laboratory facilities by the hundreds of invited guests. Highlight of the celebration was presentation of a portrait of Geo. W. Colburn by the painter, staff artist, Werner Maneck, to Mrs. Colburn.

Traid Corp. of Encino, Calif., West Coast distributor for Bell & Howell military products for the past five years, has been appointed exclusive distributor for these products throughout the United States, according to terms of a recently announced agreement. Opening of a Washington, D.C., office is scheduled for July 1. The Military Products Division of Bell & Howell was transferred to Consolidated Systems Corp., Monrovia, Calif., a subsidiary of Consolidated Electrodynamics Corp., Pasadena, Calif., following the merger of Bell & Howell with the Pasadena firm.

The Amplifier Corp. of America, a New York firm, manufacturer of professional portable magnetic tape recorders and industrial electronic test equipment has been acquired by Keystone Camera Co. of Boston, manufacturer of home movie equipment and will operate as its subsidiary. The two firms have worked together in the development of a synchronized sound slide projector for the U.S. Navy. Keystone's Vice President, Robert J. Swartz, will serve as President and Treasurer of the new corporation which will continue to operate from its New York office. Nathan M. Haynes, one of the founders of Amplifier Corp., will serve as Executive Vice-President.

Completion of a new building 150 ft by 125 ft, an addition to the plant of Goldberg Bros., 1745 Wazee St., Denver, Colo., has been announced as part of an expansion program. The entire plant now has more than 85,000 sq ft of floor space. Almost half of the new building is taken up by painting facilities. The remaining space is used for mechanical work, such as die casting, storage space and for staff and executive offices and conference rooms. The firm specializes in the manufacture of film reels and cans.

Additional warehouse facilities at 10 Pine Court, New Rochelle, N.Y., has been announced by the Syntron Division of Electro Powerpacs, Inc., Cambridge, Mass. (a subsidiary of Hydra-Power Corp., New York). Complete stocks of Syntron models are reported to be available from the new warehouse, plus repair and maintenance facilities. The firm manufactures electronic flash units and motion-picture equipment for professional, commercial, industrial and advanced amateur use.

The entire 17th floor of the Paramount Building, 1501 Broadway, New York, has been acquired by Autometric Corp., adding 12,000 sq ft of office space to that presently occupied by the firm on the 9th floor. Autometric, a subsidiary of Paramount Pictures, is a research and development organization, active in the fields of electronics, specialized mechanics and optics, color television, special purpose analog and digital computers and advanced reconnaissance and photogrammetric data reduction techniques and equipment.

Charles P. Ginsburg has been appointed Manager, Advanced Video Development, Ampex Professional Products Co. Since March 1959, he has served as Manager of Video Engineering. He is succeeded in that post by Lawrence Weiland, former NBC executive. In his new post Mr. Ginsburg will be in charge of long-range development programs.

Two new appointments have been announced by Magnasync Corp., 5546 Satsuma Ave., North Hollywood. Ralph Sogge has been appointed Director of Customer Services and L. S. Wayman has been appointed Controller. Mr. Sogge has specialized in electronics and sound in various universities and was recently associated with Purdue University and University of Nebraska as sound engineer and engineering supervisor. At the recent 87th SMPTE Convention in Los Angeles he was in charge of the public address and recording system. Mr. Wayman was formerly associated with RCA.

Lloyd A. Smith has been appointed Superintendent of the Film Emulsion Division, Kodak Park Works Plant, to fill the post left vacant by the retirement of Willis E. Whitcomb. During the past year, Mr. Smith served as Deputy Superintendent. He has been with Eastman Kodak Co. since 1930, having joined Kodak Research Laboratories as an organic chemist. He transferred to the Film Emulsion Division in 1940.

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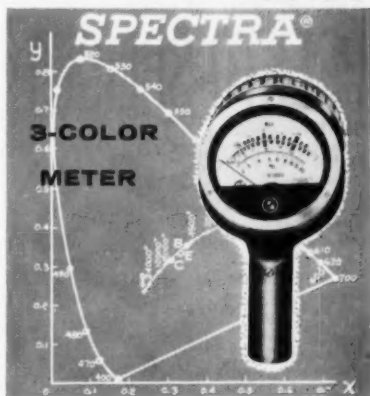


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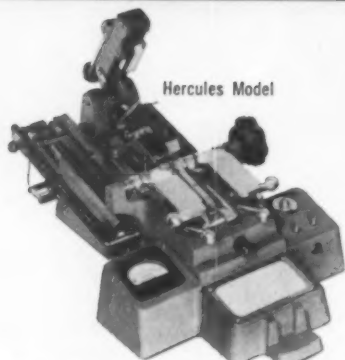


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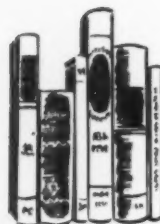
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books reviewed



The Other Side of the Moon

Translated from the Russian by J. B. Sykes. Issued by the U.S.S.R. Academy of Sciences. Published by Pergamon Press Inc., 122 East 55 St., New York 22. 36 pp. including line cuts and half-tones. 8 by 10½ in. Price \$2.85.

Through the centuries since man first discovered that the moon always turned substantially the same face towards the earth, one of his scientific curiosities has been to see what is on the other side. The January 1960 issue of this Journal contained a number of detailed discussions of the scientific possibilities presented in early October of 1959.

Well, the Russians made a first stab at it, also in October, while the Journal papers were being read. This little book is a translation of a brief paper issued by the U.S.S.R. Academy of Sciences. It tells something of what was in the space vehicle sent up to photograph the moon. It outlines the orbital conditions set up for favorable photography and a favorable return signal to the earth. It tells a little of the photographic, scanning, and signaling mechanisms used. And then it shows two photographs out of the number taken and transmitted back, and the major topographical features are named after some communist heroes (one French) and places.

The "other" face of the moon seems considerably less accidented than the face we see. In part this may come from the inevitably imperfect results of a first try. There are features, the paper says, "whose shape requires confirmation," and others "whose nature requires clarification." It will be interesting to see the details that further exploration will eventually fill in.—Pierre Mertz, Lido Beach, L.I., N.Y.

Encyclopedia on Cathode-Ray Oscilloscopes and Their Uses (2nd Ed.)

By John F. Rider and Seymour D. Usan. Published (1959) John F. Rider Publisher, Inc., 116 West 14th St., New York 11. 23 sections, 1356 pages, including contents, index, bibliography, illustrations, diagrams, and appendices, 8½ X 11 inches. Price \$27.00.

This voluminous encyclopedia is perhaps the most complete reference ever published on one of the most important pieces of test equipment. The 23 chapters provide detailed information on every aspect and important use of oscilloscopes. Incidental to its basic purpose, the circuit analyses and discussions also compose a brief but

fairly complete course in basic electronics.

The book would be an excellent addition to a reference library, and would be very useful (as a reference) to technicians. However, its use to the engineer is somewhat limited. The great majority of engineers in the electronics field are familiar with the uses, circuitry, operation, and limitations of the cathode-ray oscilloscope, and Chapter 23, which contains specifications and schematic diagrams of the majority of commercially available oscilloscopes, will soon be out of date.

Chapter 19, on the various engineering applications of the oscilloscope, is the most informative chapter. A great variety of applications are detailed, ranging from well-known applications such as the measurement of frequency to lesser known applications such as the discharges in gas. For the motion-picture engineer, the applications include testing of lenses, electronic control of photoprocessing, color correction processes and testing of photo apparatus and flash synchronization. In addition, Chapter 20, on oscilloscope photography, details the application of motion-picture and other photographic equipment to oscilloscopes, and describes currently available commercial equipment.

The book shows the tremendous effort put into its compilation and publication, and it is remarkably free of the errors which normally creep into any book of this size. It is well written, lucid, and profusely illustrated with excellent photographs and drawings. However, the general approach is that taken by the technician and, in general, the book properly belongs in a reference library rather than in a personal collection.—Harvey W. Mertz, 406 Cornwall Rd., Haddonfield, N.J.

The Special Nomenclature issue of the Journal of the University Film Producers Association (Vol. 12, No. 2, Winter 1960) contains a glossary of more than 600 key terms and definitions used in 16mm motion-picture production. The definitions have been developed through the cooperation of the American Standards Association, the Academy of Motion Picture Arts and Sciences, the Theatre Arts Department of the University of California, Los Angeles, and other colleges and universities. The glossary is planned for the "particular benefit of persons having limited familiarity with the field of 16mm nontheatrical motion-picture production. "It is not intended to be regarded as an exhaustive or final work, but it will certainly be helpful to the beginning 16mm producer wending his way through the mazes of such cryptic terms as *aspect ratio*; *A-wind* and *B-wind*; *cookie*; *crab dolly*; *dinky inky*; *parallax*—to pick a few at random.

Some of the definitions seem hardly to fall within the "special terms" category. They may even appear to presuppose extreme ignorance of the entire motion-picture world on the part of the 16mm producer. For example, *actor*—any person offering his services as a professional performer in a play or film; *emote*—to turn on emotion at will for the benefit of the camera; *title*—name or designation of a play or film . . . But this extremely minor criticism certainly does not detract in any way from the usefulness of the gloss-

sary. Even persons experienced in this field may find it of interest in keeping up with changes in the "special vocabulary" of the 16mm producer.

This issue is priced at \$1.00 for a single copy (discounts on orders of 10 or more) and is available from University Film Producers Association, c/o Motion Picture Division, 1885 Neil Ave., Ohio State University, Columbus 10, Ohio.

The Pocket Guide to Free Films, a catalog of movies available without charge to clubs, professional organizations and other groups, has been revised by Modern Talking Picture Service, Inc., 3 E. 54 St., New York 22. The 32-page booklet lists 345 16mm sound films varying from 15 min to 30 min in length. Copies of the booklet are available upon request.

Photographic Production of Slides and Filmstrips (2d ed), Kodak Publication No. S-8, is a 52-page booklet which provides step-by-step advice and instruction for the photographer who is called upon to produce specialized slide sets and filmstrips with whatever equipment and materials he may have available. The booklet is priced at 50 cents and is available from Kodak dealers.

An American Standard, Preferred Frequencies for Acoustical Measurements, S1.6-1959, has been approved. This new standard refers all frequency-series to a single reference frequency, and selects others in such a way as to afford a maximum number of frequencies common to the various series. Eleven preferred frequencies are cited from 16 to 16,000 cps. Sponsor of this standard is the Acoustical Society of America. The standard was developed with the aim of reducing to a minimum the number of frequencies at which acoustical measurements need to be tabulated. Copies are priced at 35 cents and are available from the American Standards Association, Dept. PR 140, 10 E. 40 St., New York 16.

Two new international standards recommendations for resistors and capacitors have been published by the International Electrotechnical Commission. (1) IEC Publication 115, Recommendations for fixed non-wirebound resistors Type I for use in electronic equipment, and (2) IEC Publication 116, Recommendations for receiver-type metallized mica capacitors for use in electronic equipment. Publication 115 applies to fixed resistors of types other than wirebound, with a rated dissipation not exceeding 2 w and a rated resistance value between 10 ohms and 10 megohms. The publication sets forth uniform requirements for judging the mechanical, electrical and climatic properties of the resistors. Publication 116 applies to fixed capacitors with a dielectric of mica with the electrodes directly deposited on the mica sheets and intended for use in telecommunication receiving equipment and for similar applications in other electronic equipment. The publications are priced at \$3.50 each and are available from the American Standards Association, Dept. PR141, 10 E. 40 St., New York 16.

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About 1900 American Standards are listed in the 1960 Price List and Index of American Standards, published by the American Standards Association. Also listed are the international standards recommendations of the International Organization for Standardization and the International Electrotechnical Commission. Fields covered by American Standards include automotive, chemical, civil engineering and construction, drawings, symbols, abbreviations electrical engineering, metallurgy, materials handling, mechanical engineering, mining, nuclear, photography and motion pictures, paper, petroleum, rubber, textile, wood, safety, gas appliances and some consumer goods. The Price List and Index is available without charge from American Standards Association, Dept. PR, 10 E. 40 St., New York 16.

section reports



The Chicago Section met on May 25 at Stauffer's Restaurant with an attendance of 50. Guest speakers were Charles Austin of Mitchell Camera Co., who discussed "The Mitchell R-35 Reflex Motion Picture Camera," and Walter Hicks of Reevesound Co., whose subject was "Reevesound 'Baby' Recorder."

Mr. Austin described and demonstrated the Mitchell R-35 Camera. Mr. Hicks offered a description of the Baby Recorder, the outstanding feature of which is its compactness and light weight. The whole unit can be fitted into a standard attache case.

The meeting was preceded by a Board of Manager's meeting at which the final plans for a Regional Meeting on June 3 were discussed.—Philip E. Smith, Secretary-Treasurer, c/o Eastman Kodak Co., 1712 S. Prairie Ave., Chicago 16, Ill.

The Chicago Section met on June 3 at the Furniture Club of America with an attendance of 120. Guest speakers and their subjects were: Carroll Abernathy, Fairchild Camera Corp. — "The Fairchild 8mm Camera and Projector"; Fred

O'Brien, Eastman Kodak Co. — "The Eastman 8mm Projector"; Robert Colburn, George Colburn Labs, Inc. — "Lab Practice in Striping and Print Procedures as Applied to 8mm Film"; Loren Ryder, Ryder Sound Services, Inc. — "Perfectone Portable Magnetic Recorder with Synchronous Head."

This was a regional meeting, which began at 2 p.m. with a technical session interrupted only by a coffee break and was concluded at 5 p.m. Following a social period, dinner was served at which a number of wives of guests and members were present. After the banquet, several shorts on 8mm film were shown in addition to the feature *City of Gold*.

The afternoon technical sessions covered the general topic of 8mm commercial production and effectively dealt with four phases of the general 8mm commercial program. The first talk, by Mr. Abernathy, explained and demonstrated the operation of the new Fairchild commercial 8mm Sound Camera. A sound film exposed at this meeting was rushed to the Geo. W. Colburn Labs and returned later in the day to illustrate the capabilities of the camera.

Second on the program was a talk and illustration of the Eastman 8mm Sound Projector by Fred O'Brien.

Mr. Colburn, by means of colored slides, described procedures and methods of 8mm printing and sound striping. Sample film clips were given to the audience.

The final talk was given by Loren Ryder and included a demonstration of the Perfectone portable magnetic recorder with synchronous head.—Philip E. Smith, Secretary-Treasurer, c/o Eastman Kodak Co., 1712 S. Prairie Ave., Chicago 16, Ill.

The Dallas-Fort Worth Section met on May 19 at the Convair Plant in Fort Worth with an attendance of 42. Guest speakers E. Stanton Brown, Perry King and Shields Mitchell, all of Convair, discussed "Motion Pictures and the Aircraft Industry."

Members and guests participated in a tour of the production facilities of the Convair Engineering Motion Picture Section including the studio, audio and animation equipment. Several films produced by the Motion Picture Section were shown among which were actual films of the B-58 low-altitude capabilities flight made recently from Fort Worth to the West Coast at an altitude of less than 500 feet and at a speed in excess of the speed of sound. Another film demonstrated the crew capsule ejection system of the B-58 in animation and live action. A tour of the final assembly of the B-58 was given at the conclusion of the program. — Malcolm D. McCarty, Secretary-Treasurer, 4401 Wildwood Rd., Dallas, Texas.

The Nashville Section met on May 21 at the Television Radio and Film Commission Studios with an attendance of 22.

This was a history-demonstration meeting, beginning with the film, *Movies Learn to Talk*, produced by 20th Century for TV Use. It was the story of sound movies and was very well received by the membership. There was also an exhibit of old movie equipment including cameras,

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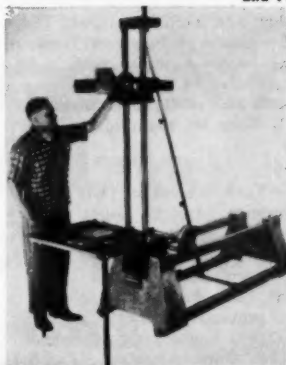


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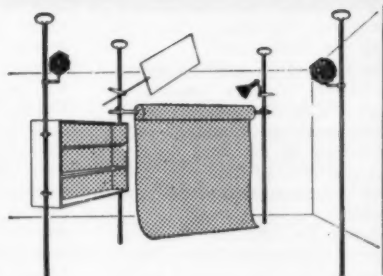
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projectors and viewers for slides. The exhibit was put together by Russ McCown, Nashville Section Chairman, and was his personal collection.

Through the courtesy of Eastman Kodak Co. there was a demonstration of the new Eastman 8mm magnetic sound projector. The quality was good but the membership, in general, seemed doubtful of the workability of the projector.

A social period followed with coffee and pastry served in the TRAFICO lunchroom. After a tour of the Commission facilities, the meeting was adjourned. This was not one of our better meetings, but it did give the members a good chance to get together and exchange ideas. There was some comment on how good it was to have some leisure time for such a get-together. — Frank M. McGeary, *Secretary-Treasurer*, c/o Motion-Picture Laboratories, Inc., 781 S. Main St., Memphis 6, Tenn.

The New York Section met on May 18 with an attendance of 87. Guest speakers of the evening and their topics were as follows: James Kunz, Technical Service Manager, Cormack Chemical Corp. — "Simplified Film Processing-Unibath (a monobath process)"; George Schneider, Chief, Electrical Engineering, Optomechanisms Inc. — "Optomechanisms KD-5 System"; Frank J. Kelly, Sales Manager, J. A. Maurer, Inc. — "Cine-Instant Method of Developing"; Seymour Schreck, Project Engineer, Specialties, Inc. — "Rapromatic S-P Technique."

Mr. Kunz opened the meeting with a description of the "Unibath" method of monobath processing and a report of the progress being made in "Unibath" processing solutions for all the usual negative and positive and reversal films now commonly used in the motion-picture and television fields.

Mr. Schneider discussed the design and development of a frame-by-frame 35mm rapid processing system as evolved in the Optomechanisms KD-5 system. While this method was developed for specific airborne data recording cameras, it was pointed out that it has possibilities as applied to the motion-picture field. The speaker also examined some of the problems met in applying the system to such equipment.

Mr. Kelly told of the Cinespeed Camera and the requirements that led to its design. A 25-second camera-to-projector time was one of the parameters set by the customer. Some of the advantages of the Cinespeed film system over video tape were discussed, among them the possibility of examining the film frame-by-frame, or at speeds other than the taking speeds.

Mr. Schreck offered the concluding discussion of the Rapromatic S-P technique, outlining some of the problems encountered in developing proper paper for use with the saturated paper system of film processing. He showed slides and demonstrated some of the effects of improper development caused by various types of saturated paper. He ended the session with a demonstration of the process by taking pictures of the audience. — James A. Kaylor, *Secretary-Treasurer*, c/o Movielab Film Laboratories, Inc., 619 West 54 St., New York 19.

The Rochester Section met on May 19 at the Dryden Theatre with an attendance of 62. Walter Kisner of Eastman Kodak Co. was guest speaker. His subject: "Control Techniques in Film Processing."

The meeting was opened with a novel and entertaining film, *The Travel Game*. Mr. Kisner presented a brief review of the forthcoming Society sponsored book on "Control Techniques in Film Processing." The presentation was excellent and the subject matter of real interest. Mr. Kisner, the committee and others contributing to the publication are to be commended for a job well done.

The students' papers program for the evening was introduced by Hollis Todd, Student Advisor at the Rochester Institute of Technology. This part of the program was organized by the student chapter of the SMPTE and the photographic fraternity, Delta Lambda Epsilon, at RIT. The papers presented at the session were chosen from those submitted by the two-year students and those submitted by the four-year students. A first prize and an honorable mention were awarded in each group.

Judges selected to review the papers submitted were: Ralph M. Evans, Director of Color Technology Division, Eastman Kodak Co.; Dr. C. J. Staud, Vice-President in charge of Research, Eastman Kodak Co. and M. G. Anderson, Manager, General Quality Control, Ansco.

Dr. J. A. Leermakers, Research Laboratories, Eastman Kodak Co., presented awards to the following: First Prize to Myron Berkovitz of the two-year division for his paper, "The Sabattier Effect"; Honorable Mention to Donald Gaffney and Stephen Farrell for "The Tone Reproduction in Black-and-White Prints from Color Negatives." Richard Burkhardt received First Prize in the four-year division for his paper, "Development Determination by Infrared Densitometry," and Richard Walker was given Honorable Mention for his "Reversal Characteristics of a Negative Emulsion."

This program was very well received and tentative plans are being made to continue this type of competition in the future, according to reports from Hollis Todd and our program chairman, Eric Johnson.

We were fortunate to have in the audience Dr. Norwood L. Simmons, President of SMPTE. Dr. Simmons commented on the fine presentation by the students. — W. G. Hill, *Secretary-Treasurer*, 10 Hillcrest Ave., Binghamton, N.Y.

The San Francisco Section met on May 17 at the Studios of KGO-TV with an attendance of 25. Guest speaker William High, Director of Photography, Oakland Junior College, discussed, "Combat Photography."

Mr. High told of his personal experiences as a combat photographer in the E.T.O. during World War II. Under discussion were the training and methods of operation of the average combat photographer. Both motion-picture and still-picture equipment types were pointed out and illustrated. A series of slides and a 25-min film, made in part by Mr. High, were shown. — Frank Mansfield, *Secretary-Treasurer*, 57 Stoneyford Ave., San Francisco 24.



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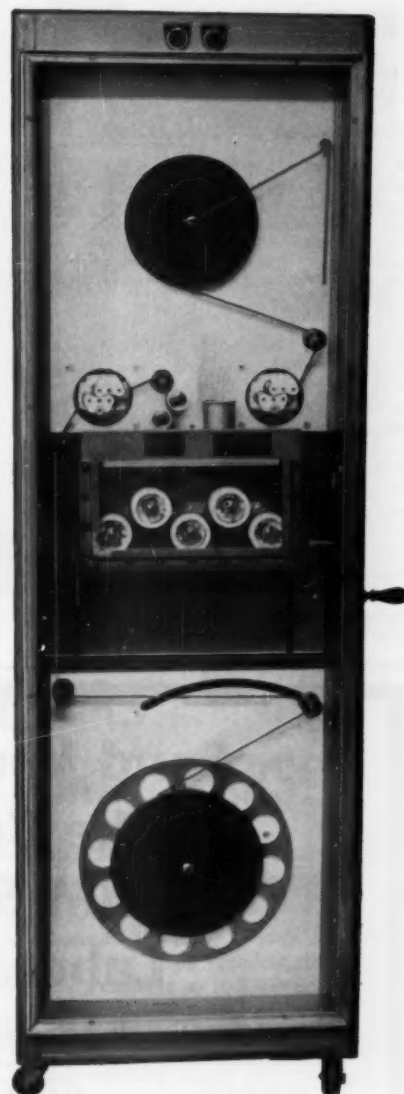
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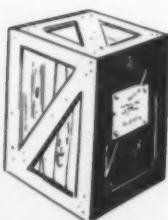
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new products

(and developments)

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Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

On May 8, 1960, at 5:40 A.M., Eastern Daylight Time, a command signal was sent from the 250-ft radio telescope at Manchester, England, to the 150-w transmitter on the space ship, Pioneer V, at that time more than eight million miles from Earth. It took about 90 seconds to send the command and receive back a response — an event of considerable importance in the development of interplanetary communication. The 94.8-lb space ship (or space probe) was launched from Cape Canaveral, March 11. A 5-w transmitter telemetered information daily until May 7, when it was apparent that the transmission



limit had been reached. The 150-w transmitter was then energized. First, a signal was sent to the space ship which put power into a tube filament through a current-limiting resistor, thereby warming the resistor for about a minute. About four hours later this signal was repeated and a second command sent which removed the current-limiting resistor, supplying full filament heating for several minutes. The following day (May 8) the final command signal was sent, energizing an electric converter and the 150-w transmitter, both having remained idle in the "hard" vacuum of space since launch, undergoing constant radiation.

The transmitter weighs about five pounds and measures about seven by five in. It contains an amplifier tube together with capacitors, coils and resistors. Because of the enormous power drain imposed on the system by the 150-w unit, it is operated only about two or three minutes every six to eight hours. Data is received at the rate of either 8 or 64 bits/sec.

Power for the probe comes from 4800 solar cells in four arms jutting from the 26-in. spherical package. The solar cell output constantly charges 28 chemical batteries, the size and shape of standard flashlight batteries. These in turn power more than 40 lb of experiments, electronics, a receiver, transmitters, and associated logic units. Within two months after launching Pioneer V returned more than 109 hours of data on cosmic radiation, charged particle energies and magnetic field phenomena. Pioneer V was launched under the direction of NASA with executive manage-

ment supplied by the Air Force Ballistic Missile Division.

A number of other contractors contributed to this interplanetary experiment as well as many scientists. A special word of appreciation was given Space Technology Laboratories, Inc., of El Segundo, Calif., by NASA administrator, T. Keith Glennan, who spoke of the "outstanding job of payload instrumentation and tracking" performed by the firm.

Experiments conducted at Bell Telephone Laboratories, 463 West St., New York 14, with a low-noise antenna and receiver combination are expected to contribute to the forwarding of work on transoceanic communication by the reflection of electromagnetic signals from passive Earth satellites. The experimental device is a horn-reflector antenna, approximately 18 ft long, coupled to a low-noise traveling wave maser that amplifies in one direction only. With the horn-reflector pointing vertically skyward an overall input temperature of 17.6 K was observed at 5.65 kmc. The ultimate sensitivity of an Earth-based communication system is limited by the thermal noise in the Earth's atmosphere. The aim of this and similar experiments is to extend the range of communication by employing low-noise amplifiers that do not pick up signals originating behind and to the sides. The report on the experiment stated that such devices could be useful in investigating interplanetary radio signals of all kinds "regardless of origin."

The inside of a living human stomach has been filmed in color for the first time by means of a technique combining the use of glass fiber optics and high-speed film. The technique was developed by Henry Colcher, M.D., and George M. Katz of the Columbia University Research Service Goldwater Memorial Hospital and the Columbia-Presbyterian Medical Center. In making a motion picture of the stomach's interior, an 8 mm camera is mounted on the eyepiece of a gastroscope and a bundle of light-transmitting glass fibers attached to the tube of the gastroscope carries light into the stomach. The illumination provided by the bundle of glass fibers is of a relatively low level but sufficient for making satisfactory motion pictures when a suitable film is used. For this "movie" special rolls of 8mm Ektachrome ER were supplied by the special sensitized products sales department of Eastman Kodak Co. in cooperation with the medical technical service center. The film was made at the rate of 8 frames/sec.

A new developmental semiconductor device called a double-emitter transistor was described in a paper by L. Plus and R. A. Santilli of the RCA Semiconductor and Materials Division presented at the IRE Convention held in New York in March 1960. The multipurpose device combines within one unit the functions of separate oscillator and mixer normally accomplished by two transistors. The multijunction, drift-field transistor has two alloyed p-type emitters, an n-type base, and one alloyed p-type collector. The two emitters are processed so that they can function independently of one another.

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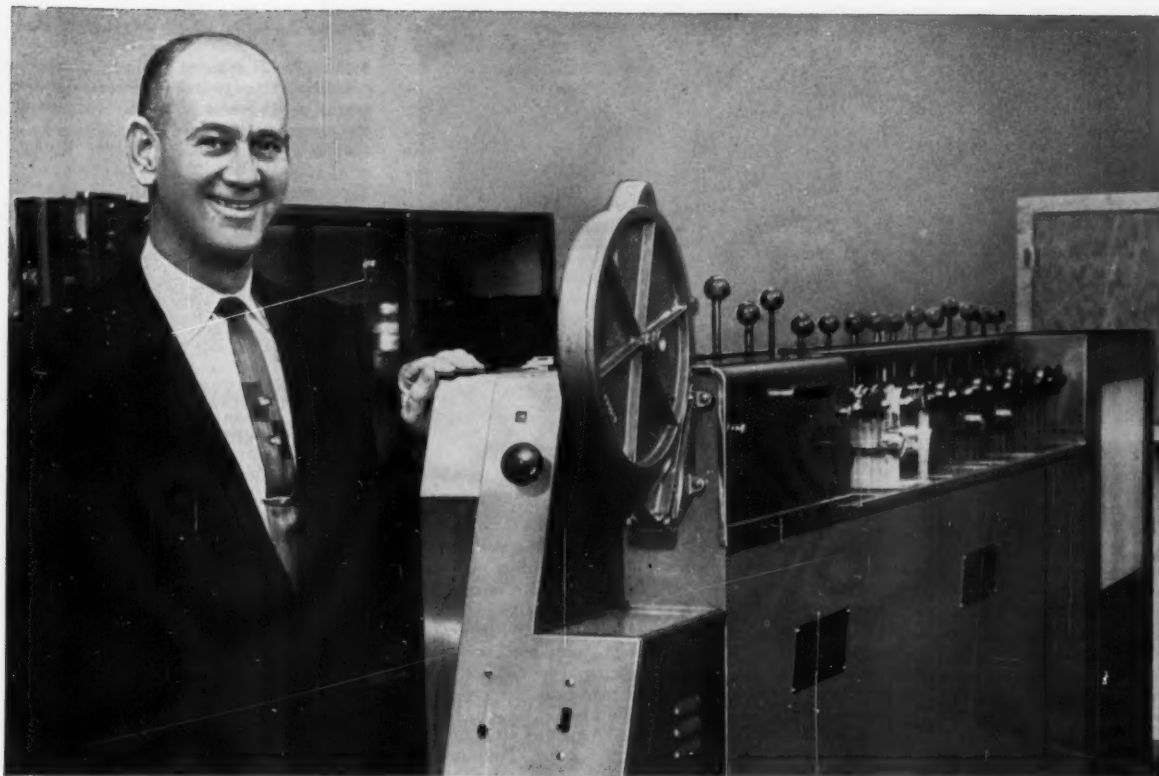
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Two new Videotape* Recorders, the 1000C and 1001A have been announced by Ampex Professional Products Co., 934 Charter St., Redwood City, Calif. The "A" model, designed especially for mobile installations or studios where space is limited, is a smaller, more compact version of the "C" model. The basic unit of the "A" model occupies only 11 sq ft of floor space and the weight has been reduced from 780 lb to approximately 500 lb. Both machines can be equipped for recording color television and both ma-

chines can be equipped with a new unit for special effects such as split screen, dissolves, wipes, fades, etc. The unit also permits mixing of pretaped sequences, slide sequences etc., onto one composite tape, without splicing. Performance specifications for the new recorders include a frequency response of ± 1 db at 1.0 mc, in the range from 0.5 mc to 4 mc; down no more than 3 db at 4.2 mc. Transient response is a maximum of 8% overshoot on keyed sync pulses of 0.1 μ sec risetime, of amplitude 20 to 8 IRE units; d-c response

provides less than 2% tilt with standard window test signal. (*TM Ampex Corp.)

A simplified system for automatically preparing electronic data-processing programs to be used with the Honeywell 800 data-processing programs (*Jour.*, Feb. 1960, p. 147) has been announced. Known as FACT (Fully Automatic Compiling Technique) the system is designed to eliminate manual program coding by enabling the computer to translate simple statements in English into its own detailed machine instructions. A 94-page manual, "FACT—a New Business Language," is available from Minneapolis-Honeywell, Datamatic Division, Wellesley Hills 81, Mass.

A compatible stereo broadcasting system based on an acoustic phenomenon known as the "precedence effect" has been demonstrated by Bell Telephone Laboratories. A detailed description of the system has been published in the *Bell Laboratories Record* for November 1959.



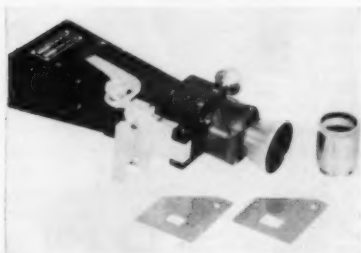
A camera system designed for military and industrial applications requiring especially rugged equipment has been announced by Foto-Video Electronics, Inc., 36 Commerce Rd., Cedar Grove, N.J. The system, called the Model V-515, consists of a vidicon camera and camera control unit. The camera head accepts all C-mount lenses including 16mm and special vidicon types. An 8-mc high gain, low noise cascode preamplifier with high peaker feeds a low impedance cable matching stage for driving the cable to the monitor control unit. Overall response is flat to 8 mc. The control unit contains an electronically regulated power supply, a video amplifier, vertical and horizontal deflection circuits. The video amplifier is provided with adjustable aperture correction for high definition. Adjustable phase correction is used to prevent smear or overshoot due to high frequency phase error. A keyed clamp is used to insure accurate d-c setting regardless of picture content. The plug-in all-transistorized synchronizing chassis provides composite blanking to the camera control unit video processing section, plus V and H drive to the deflection generators. The camera



weighs 4 lb and is 8½ in. long, 3½ in. wide, and 4 in. high. The control unit is 19 in. wide for rack mounting, 5½ in. high and weighs 50 lb. The system is priced at \$2400.



A closed-circuit TV camera, Type TE-9-A has been developed by the Technical Products Operation of General Electric Co.'s Communication Products Dept., Mountain View Rd., Lynchburg, Va., for use under extreme conditions of vibration and noise. The single-unit, transistorized camera is self-contained and is easily moved from one location to another. Cylindrical in design, it is 11½ in. long, 5½ in. in diameter and weighs 9 lb. It uses standard 16mm lens and is equipped with a remote turret for mounting four lenses at one time. The camera is extremely sensitive and is reported to be usable down to 1.0 ft-c scene illumination. It is designed to operate over a temperature range of 80 C. It operates on a power input of 18 w. It has a rugged housing to protect it from outside electrical interference such as radar, radio transmitters and car radios. Suggested applications include military, industrial and educational fields.



The M-H Professional Viewfinder, distributed by S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19, is designed for use with 16mm Auricon, Bell & Howell, Bolex and Cine Special cameras to provide a 2 by 3-in. image corrected from right to left. The focusing and parallax controls range from 2 ft to infinity and an engraved aperture outline with crosshairs in the center shows the field of the standard 25mm lens for 16mm cameras. A secondary magnifying lens gives an enlarged view.

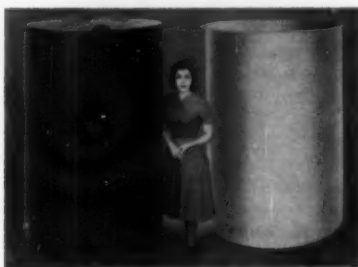
Film-O-Tape, the tape-to-film transfer service offered by General Film Laboratories, 106 W. 14 St., Kansas City 5, Mo., is described in the April 1960 issue of *Revind.* The transfer equipment includes both 35mm and 16mm equipment for film recordings from video tape; from coaxial cable or microwave relay link; from film originals projected and transmitted through

the firm's closed-circuit system, or off the air. The transfer is to a composite negative or to separate picture and sound negatives for printing in either the A-wind or B-wind positions. A separate 16mm magnetic sound record may be made, or a direct positive photographic print if only one copy is desired.

A new special effects device, the Wind-maker Moleffect, has been announced by Mole-Richardson Co., 937 N. Sycamore Ave., Hollywood 38. Designed for studio use to produce maximum air flow with minimum noise, a directional air stream can be obtained by the use of vanes or the air stream can be broadened by removing the vanes. Operating on either a-c or d-c the 74-lb unit consists of a three-blade fan enclosed in a steel wire guard and an enclosed motor. It is 20½ in. in diameter and 17½ in. in length. It is priced at \$492.

A new black-and-white motion-picture film, the Eastman Double-X Panchromatic Negative Film, Types 5222 (35mm) and 7222 (16mm), was introduced by Eastman Kodak Co. at the Society's 1960 Spring Convention in Los Angeles. Recommended exposure index for the new film is daylight 250, tungsten 200, which is about three times as fast as Eastman Plus-X Panchromatic Negative Film. The increased speed of the new film is said to give the cameraman better control over depth-to-field and low-key lighting situations, with little sacrifice (if any) in screen definition or graininess. At present, the new film is in limited supply.

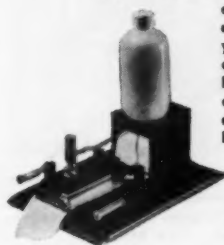
A new print film, Ektachrome Reversal Print Film, Type 7386 (16mm) and Type 5386 (35mm), has been announced by the Motion Picture Film Department of Eastman Kodak Co. It was developed especially for producing high-quality projection prints from Eastman (or Kodak) Ektachrome ER Films (Daylight Type, E.I. 160; Tungsten Type, E.I. 125) which were released a few months ago. Standard techniques and equipment used for the ER films will process the new print material at a rate of approximately 30 to 50 ft/min. The new print film is also available in 70mm widths upon special order.



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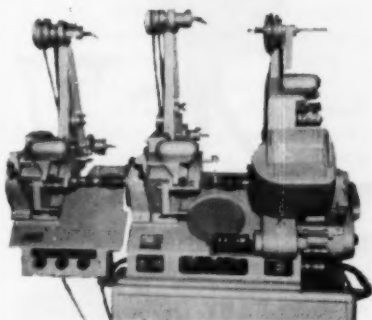


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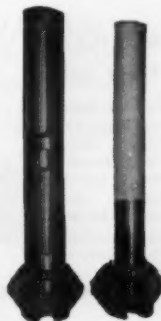
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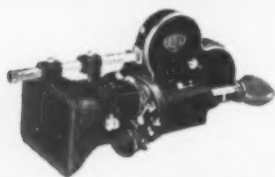
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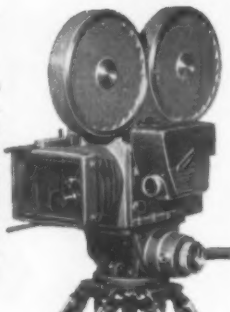
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Storage equipment specially designed for language laboratory magnetic tapes has been announced by Neumade Products Corp., 250 W. 57 St., New York 19. Features include color coded subject indexing and position retaining and key locks on all cabinets. A cabinet with a 500-tape capacity is priced at \$360.



The Varotal Mark III is a TV zoom lens introduced by Taylor, Taylor and Hobson Division of Rank Precision Industries, Ltd., 37-41 Mortimer St., London W.1., and used for the first time in Westminster Abbey to photograph the wedding of Princess Margaret. The lens is 27 in. long, weighs 33 lb and incorporates 13 separate glass elements. The focal length is continuously variable within minimum and maximum focal lengths in the ratio of 5:1 and has two overlapping focal ranges, 4 to 20 in. $f/4$ and 8 to 40 in. $f/8$. The range of focusing distance goes from infinity to 12 ft. It is designed for adaptation to all types of image orthicon cameras.



A new version of the Super-Farron Lens called the Backward Curving Field Super-Farron has been announced by Farrand Optical Co., Bronx Blvd. & E. 238 St., New York 70. Designed for use with new types of high amplification image intensifiers and intensifier orthicons having curved cathodes, the lenses form an image on a surface convex to the objective having a radius of curvature of 4.00 in. The new lenses are available corrected for 16:1 and 4:1 conjugates in addition to standard infinity correction.



A Telefold lens designed to offer a long focal length system in a short, light-weight package has been announced by Atlantic Research Corp., Alexandria, Va. The lens is 10 in. long, 5 in. in diameter and weighs 10 lb. It uses a catadioptric system which permits a 42-in. focal length to be folded in a 10-in. tube with a focusing system ranging from 2 ft to infinity. Designed for use with a single lens reflex focusing camera, it can be adapted for use on television cameras and on 8mm, 16mm and 35mm still and motion-picture cameras. The lens is priced at \$695.



The Slide Plate Readout, a readout display that operates directly from binary input, has been announced by Industrial Electronic Engineers, Inc., 5528 Vineland Ave., North Hollywood. Designed to eliminate the need for a decoding device to translate binary information into decimal information, it automatically decodes any BCD code up to six bits into numeric, alphabetic, or special symbol character presentation. It is used with digital computers, control equipment, instruments and other electronic or electrical test equipment, or it will work directly from teletype machines. The unit provides 16 digits or special characters and operates on a light-interference principle. Dimensions are 3½ in. high, 1½ in. wide and 7 in. long and the character

displayed on the front viewing screen is 1½ in. high. It weighs 2 lb 4 oz. It is priced at \$40.

The firm has also announced an In-Line Digital Display operating on a rear projection principle. All the wiring is at the rear of the unit for ease of installation. The viewing screen is 1½ in. wide and 2 in. high. Digit or character display is 1 in. high. The unit is priced at \$18.

A new line of Filmline processing machines for 8mm/16mm and 35mm Kodachrome film, which includes two economy-priced models, the 16KC26 and the 35KC13, has been announced by Filmline Corp., Milford, Conn. Model 16KC26 is designed to process 8mm/16mm Kodachrome at a speed of 26 ft/min or 62 rolls (25-ft DBL 8mm) per hr. The basic machine is priced at \$34,850. Model 35KC13 is designed to process 35mm Kodachrome at a speed of 13 ft/min or 260 rolls (35mm 20 EXP) per hr. It is priced at \$35,925. Both machines are constructed of type 316 stainless steel. Control and accessory equipment for either machine is available in control units costing \$8,765 to \$12,925.

Two other new models are the 16KC60, a 16mm processor with a speed of 60 ft/min, and the 35KC45, a combination 16mm and 35mm processor, with separate racks and drive systems using common chemistry. Speed on 16mm is 45 ft/min and on 35 mm is 8 ft/min. Either 16mm or 35mm can be run interchangeably, alternately, or at the same time. Both models utilize a bottom drive with separate racks easily removed by lifting the rack from the machine without the necessity of disengaging couplings. It is replaced with an automatic drop engagement. The film rack drive is gear operated with no interconnecting chains between the drive mechanism and the racks. Other features include stainless-steel wet section with red brass bleach tank; recirculation pumps and thermistor temperature control, including heat and refrigeration, with vernier control for all five developer solutions; spray washes and solution turbulence; and other special controls. The equipment is designed to permit expansion of the machine with the replacement and addition of tanks to meet possible future changes in the Kodachrome process. Model 16KC60 is priced at \$74,725 and Model 35KC45 is priced at \$111,000.

A new lightweight, low-drain portable transistorized broadcast amplifier has been introduced by General Electric Co. The model was shown as part of the company's exhibit at the NAB convention in Chicago. It is designed for use on AM-FM-TV and recording audio applications and is said to be suited for broadcasts of sports events, spot news and music programs. Called the BA-26-A, the unit weighs 19.5 lb. It is 15¼ in. wide, 6¼ in. high and 13¼ in. deep. It also contains a built-in tone generator for setting up signal levels.

An electric film timer, a product of Camera Mart, Inc., 1845 Broadway, New York 23, is designed for use for narration, post-recording, dubbing, or any operation involving synchronous film timing. Two synchronous timing meters and two footage



counters measure total footage and its equivalent time in minutes and tenths. A 16mm or 35mm footage counter with timer is priced at \$85.



A "tightwind" which operates on a ball-bearing roller is a product of Camera Mart, Inc., 1845 Broadway, New York 23. Called the Camart Tightwind, it is designed to wind film smoothly and evenly and to fit any 16mm or 35mm standard rewind. It is priced at \$34.95.

The Lectronotch delay timer, designed for laboratory use in compensating for spacing differences in motion-picture printing cue systems, is a product of S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19. The variable time delay unit is for use in laboratory situations where the problem arises of running negatives notched for a particular machine on another type of printer with a longer scene-to-notch spacing. Various methods, such as patching and renotching, have been used. The time-delay unit delays the impulse to the light-change mechanism until the correct frame is in position. Prototypes of the unit have been used in laboratories of the National Film Board of Canada. It is now commercially available at a price of \$195.

An underwater communication system that enables two or more divers to converse within a radius of 150 ft at depths up to 120 ft has been announced by Electro-Voice, Inc., Buchanan, Mich. The system, called the Scubacom, is made up of two basic components, the mask-microphone, a specially designed partial face mask containing the microphone, and the speaker-amplifier which is strapped to the diver's air tank. Signal voltages from the mask-microphone are fed to the transistorized amplifier by means of a special waterproof interconnect cable. The system

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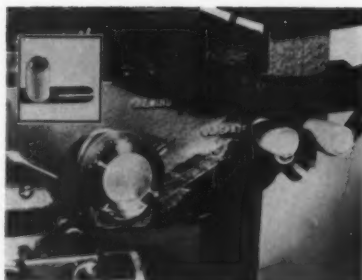
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is powered by two standard pressurized underwater batteries. The housing is made of expanded polystyrene (Deraspan) with an overcoating of Gel-Coat and the mask and harness are of neoprene and natural rubber. The system is priced at \$210.

A device called a **rapid-scan monochromator**, which continuously records the intensity of infrared radiation from missile plumes over a selected waveband, is used in studies currently being conducted by Perkin-Elmer Corp. of Norwalk, Conn., under contract with the Air Force Cambridge Research Center. The 8-in. aperture infrared rapid-scan instrument is mounted under a 24-in. aperture ROTI missile tracker to make spectrometric studies of power flight portions of missile firings from Cape Canaveral. The data collected indicate, among other things, the nature and rates at which "function of time" reactions occur during powered flight. Analysis of inflight plume characteristics may yield information pertinent to the development of more efficient and more exotic fuels and engines.

FilMagic Pylon, a lubricant dispenser for lubricating strip material, has been announced by the inventors, W. Wells Alexander and Russell M. Magee, President and Treasurer, respectively, of The Distributor's Group, Inc., 204 14 St., N.W., Atlanta 13, Ga. The device is designed to protect films and recording tapes by apply-



ing a coating of fluid silicones to the moving surfaces while the reproducing equipment is operating. In operation the lubricant is filtered from a reservoir of fluid silicones through a removable sleeve onto the tape or film as it passes through the reproducing mechanism. The silicone coating sets up an invisible protective barrier against heat and abrasion, and the moving tape or film surface is used as a "carrier" of protective silicone into parts of the equipment otherwise impossible to lubricate.

The **RCA Industrial Television Catalog** is a 112-page catalog listing and describing closed-circuit television equipment for industry. It covers such equipment as cameras, housings, lenses, monitors, switchers, microwave equipment and tape recorder. It is available by writing on company letterhead to Radio Corp. Of America, ITV — Dept. 759, Bldg. 15-1, Camden 2, N.J.



employment service

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These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Cinematographer. 25 yrs experience black-and-white and color, 35 & 16mm; 5 yrs theatrical production in Europe; 20 yrs industrial, commercial, educational and documentary films; recently worked 12 yrs with General Motors Audio-Visual Photographic Dept.; further background information available. Desires connection with producer of industrial, educational or travel films. Free to travel; speak several languages. J.P.H., Box 375, College Park Station, Detroit 21, Mich.

Producer-Manager or Laboratory Production Supervisor. Independent producer in 16mm sound films and industrial and color still photography desires position with large company. No capital to expand plus limited market prompts move. Married, 28 yrs old. B.A. and part M.A. in communications. Experienced PR man. Ex-Marine. Best of references. Owns complete motion-picture and still production and lab equipment. Résumé on request. Write: DH, Box 118, Missoula, Mont.

Television Producer-Director. With a broad background in both educational and network level commercial television. Experience in radio production and sales, and also a knowledge of merchandising. Both B.A. and M.S. degrees. Currently employed, but willing to move to a position where hard work and ability will lead the way to opportunity. Willing to locate anywhere in the U.S. Married. Résumé and references supplied on request. Write: Richard R. Ferry, Apt. 112, 14 Buswell St., Boston, Mass.

Motion-Picture Production Associate. Univ. S. Calif., Dept. of Cinema, graduate, age 26. Experience as cameraman, editor and sound mixer with National Educational Television and Radio Center at Univ. of Illinois Math Study. One yr project ends July 1, 1960. Desire permanent position as cameraman, editor or sound mixer. Resume and references on request. John A. Werner, 317 S. Russell St., Champaign, Ill.

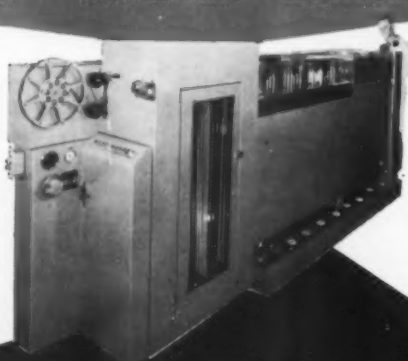
Assistant to Top Executive. Willing relocate or travel. Administrator-Consultant-Technician all phases photo industry USA and abroad. Production, sales and sales promotion; along with extensive processing, recording and editing experience. Planned, erected, installed and operated studios and labs in many locations. SMPTE member some 25 years 10 Brookside Drive, Apt 4D Greenwich, Conn. TOWnsend 9-5090.

Sound Recording Technician. Cuban, 30, married. Over 12 yrs experience all types mixing for radio, television, records and film; recording on tape, disk and 16mm optical; multitrack re-

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Director, Producer, Cameraman, Instructor. Practical and admin. experience in educational and TV film production, also in 16mm motion-picture laboratory supervision and still photography. Masters Degree in Cinema, Univ. So. Calif. Present contract as Film Unit Director for the National Education Television Mathematics Film Study, Univ. of Illinois, ends Sept. 1, 1960. Age 32, married. For résumé write or call: Byrl L. Sims, 1102-A West Main St., Urbana, Ill.; EMpire 7-6611, Ext. 3837.

Motion Picture Editor and Cameraman. Presently with N.E.T.R.C. Math Study Film Project at Univ. of Ill. as Head Editor and Head Cameraman. Formerly with N.O.T.S. China Lake as Cameraman and Editor. B.A. and part M.A. from Univ. of Southern Calif. Dept. of Cinema. Also experienced in motion picture laboratory, still work, and other aspects of film production. Interested in a challenging position with potential. Write or telephone for resume or Form 57; day: EMpire 7-6611, ext. 3837; night: EMpire 5-1038; Stanley Follis, 1311 South Cottage Grove, Urbana, Ill.

Sound Engineer. Young Indian desires position as sound engineer in a well-established organization. Brilliant academic career. Graduate in Science. Three years Diploma in Sound Engineering. Well versed in equipment maintenance and procedures and motion-picture laboratory practice. Enterprising and hard-working. Prepared to work as 'Apprentice Trainee', if desired. Member of Audio Engineering and Associate Member of SMPTE. Write: M. K. Srivatsa, 17, Rangarao Road, Shankarapura, Bangalore-4, India.

Trainee. Israeli student, 31, motion pictures graduate UCLA '60, speaks 7 languages, with rich background in public relations, needs opportunity for practical training in any phase of cinematography or television production. Will travel. New York or Los Angeles areas preferred. Write P.O. Box 24533, Los Angeles 24.

Writer-Director. Experienced in production of technical, educational, training and promotional films. Background includes editing, camera and sound. Experienced in military electronics field. Desires position with unit actively engaged in production. Married, BA degree, willing to relocate. Write: Film Director, 4813 "B" St., Philadelphia 20, Pa.

Producer-Director. Winner of national awards. Currently employed, but desirous of obtaining challenging position where hard work, enthusiasm and ability are needed. Experienced in all phases of production. Capable of handling crews and supervising production from script to screen. Background in industrial and educational films. College cinema grad. Write: Producer, 3100 Kelton Ave., Los Angeles 34, Calif.

Motion-Picture Engineer. B.Sc. Elect. Eng., 15 yrs experience all engineering phases motion-picture production and services, mainly sound recording. Administrative and management experience as well as complete layout, design, installation, operation and maintenance of two sound recording studios. Fellow SMPTE, member of Sound Committee. Age 38, married, fully

bi-lingual, French and English, would relocate. R. J. Beaudry, 9 Badger Dr., Toronto 18, Ont., Canada.

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Photo Chemist/Chemical Engineer. Outstanding, creative opportunity for graduate chemical engineer or photo chemist with broad basic knowledge of processing techniques and solutions including minimum of 2 yrs experience with image transfer materials. Desire ambitious engineer with 10 yrs photographic experience for attractive opening in new product development. East coast location. Our employees know of this ad. Box MPTV 1944, 125 West 41 St., New York 36.

Sound Technician. GS-9, \$5985 per yr. Duties involve operation, servicing and maintenance of complete 16mm sound recording system, including making of original magnetic tape recordings, rerecordings and optical recordings. Interested parties should apply by sending a resume or standard Government application form (Form 57) to Industrial Relations Department, Pacific Missile Range, Naval Missile Center, P.O. Box 4, Point Mugu, Calif.

Chief Engineer. To take charge of product development and diversification program for well known manufacturer of tape recorders and audio equipment. Company located in Chicago requires man with strong engineering background and knowledge of audio circuitry. Experience with magnetic recording devices and systems will be helpful but not necessary. Ability to operate at top executive level is essential. Five figure salary and other incentives. Send data on background and experience confidentially to: John M. Watkins, Suite 1604, 28 East Jackson Blvd., Chicago 4, Ill.

Electronic Engineers. Circuits and Systems, Development and Design in fields of Broadcast and Closed-Circuit TV, both Commercial and Military. Transistorized Circuit experience necessary. Fastest-growing company in field. Many benefits. Profit-sharing in ownership available. Foto-Video (Electronics, Inc.) 36 Commerce Rd., Cedar Grove, N. J. CEnter 9-6100.

Motion - Picture Production Salesmen. Excellent opportunity for men in all corners of the world to affiliate themselves with a new motion - picture production unit. Salesmen should have contacts in industry, public relations and advertising fields to sell motion-picture and film-strip productions. Write giving full details of area you can cover. Allegro Film Productions, 723 Seventh Ave., New York 19.

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Film Inspectors, Film Librarian. Temporary or permanent. Write or call Peerless Film Processing Corp., 165 W. 46 St., N. Y. 36 Tel. Plaza 7-3630. Att: Kern Moyse.

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<i>UFPA Journal, The Pocket Guide to Free Films, Photographic Production of Slides and Filmstrips (2nd Ed.), American Standard, Preferred Frequencies for Acoustical Measurements, S1.6-1959; IEC Standards Recommendations for Resistors and Capacitors; 1960 Price List and Index of American Standards; Precision Switch Catalog.</i>	
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Meeting Calendar

Medical Electronics, International Conference, July 21-27, Olympia, London, England.

Computers and Data Processing Symposium, July 28-29, Denver Research Institute, Stanley Hotel, Estes Park, Denver.

SPIE, 5th Annual Technical Symposium, Aug. 1-4, Ambassador Hotel, Los Angeles.

AIEE, Pacific General Meeting, Aug. 8-12, 1960, San Diego, Calif.

National Audio-Visual Convention, Aug. 6-9, 1960, Hotel Morrison, Chicago.

International Astronautical Federation Congress, Aug. 15-20, Stockholm, Sweden.

Western Electronic Show and Convention, Aug. 23-26, Los Angeles.

Electron Microscope Society of America, Annual Meeting, Aug. 29-31, Marquette Univ., Milwaukee, Mich.

European Conference on Electron Microscopy, Aug. 29-Sept. 3, 1960, Delft, Netherlands.

Standards Engineers Society, Sept., Pittsburgh, Pa.

Illuminating Engineering Society, National Technical Conference, Sept. 11-16, Penn Sheraton Hotel, Pittsburgh, Pa.

International Scientific Film Association, 14th Congress, Sept. 16-24, Prague, Czechoslovakia.

Deutsche Gesellschaft für Photographie, 1st International Congress on Medical Photography and Cinematography, Sept. 27-30, Düsseldorf, Germany.

Armour Research Foundation & IRE, 6th Conference on Radio-Interference Reduction and Electronic Compatibility, Oct. 4-6, Museum of Science and Industry, Chicago.

ASCE, National Convention, Oct. 9-13, Boston, Mass.

Electrochemical Society, Meeting, Oct. 9-13, Shamrock Hotel, Houston, Texas.

AIEE Fall General Meeting, Oct. 9-14, Chicago.

NEC National Electronics Conference, Oct. 10-12, 1960, Hotel Sherman, Chicago.

Optical Society of America, Annual Meeting, Oct. 13-15, Somerset Hotel, Boston, Mass.

Fifth International High-Speed Congress and Equipment Exhibit, sponsored by the SMPTE, Oct. 16-22, 1960, Sheraton-Park Hotel, Washington, D.C.

Symposium on Space Navigation, Oct. 19-21, 1960, Columbus, Ohio.

Acoustical Society of America, Fall Meeting, Oct. 20-22, San Francisco.

AIEE, API, ONR, IRE, Metallurgical Society, Sixth Annual Conference on Magnetism and Magnetic Materials, Nov. 14-17, New Yorker Hotel, New York.

ASME, Annual Meeting, Nov. 27-Dec. 2, Statler Hilton Hotel, New York.

American Association for the Advancement of Science, Annual Meeting, Dec. 26-31, New York.

ISA, Winter Instrument-Automation Conference and Exhibit, Jan. 16-19, 1961, Sheraton-Jefferson Hotel & Kiel Auditorium, St. Louis, Mo.

ISA, 7th National Symposium on Instrument Methods of Analysis, Apr. 17-19, 1961, Shamrock-Hilton Hotel, Houston, Texas.

89th Semiannual Convention of the SMPTE, May 7-12, 1961, King Edward Sheraton, Toronto.

90th Semiannual Convention of the SMPTE, Oct. 2-6, 1961, Lake Placid, N.Y.

91st Semiannual Convention of the SMPTE, Apr. 30-May 4, 1962, Ambassador Hotel, Los Angeles.

92nd Semiannual Convention of the SMPTE, Oct. 22-26, 1962, Drake Hotel, Chicago.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters and of the Committee Chairmen and Members were published in the April 1960 Journal Part II.

sustaining members

of the Society
of Motion Picture
and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of high professional standing among its members;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

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The Society invites applications for Sustaining Membership from other interested companies. Information may be obtained from the Chairman of the Sustaining Membership Committee, Byron Roudabush, c/o Byron Motion Pictures, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C.

